OrthoCarolina

Evaluation & Management of Femoroacetabular Impingement

Alexander Bitzer, MD

May 21, 2021

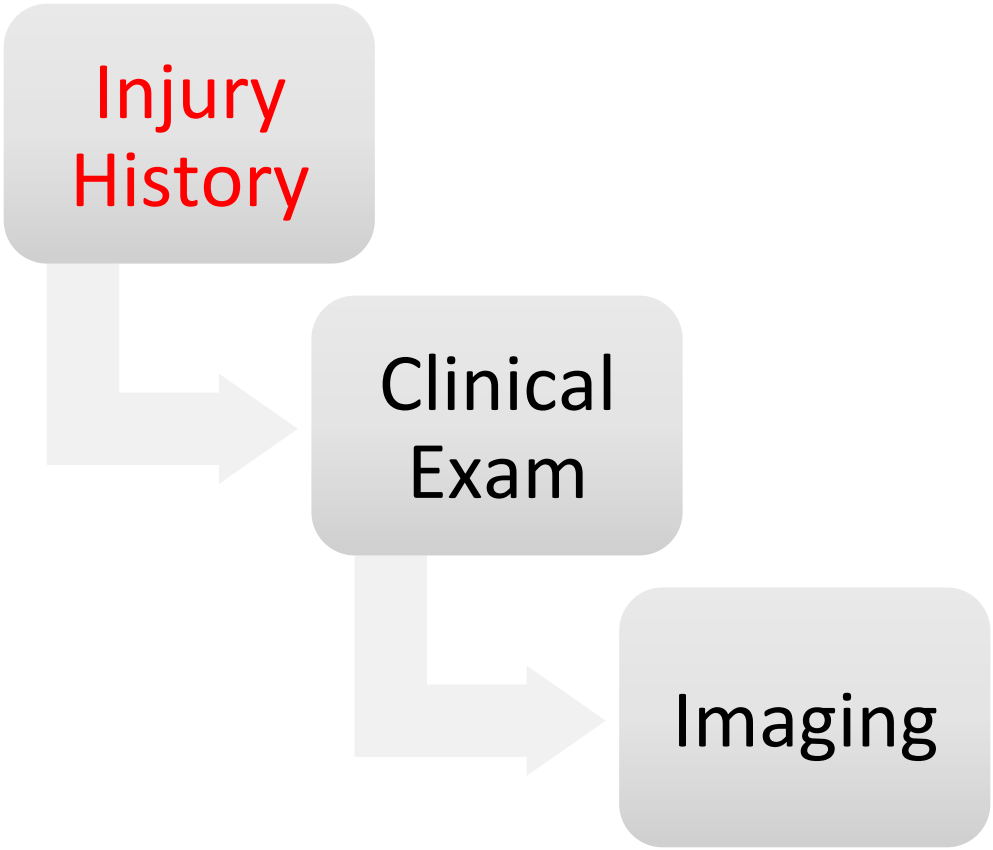
Disclosures

- none

Hip Pain Adolescent/Young Adult

- Intra-articular
  - **FAI**
  - Labrum: tears
  - Chondral: Injury, OA
  - Capsule: sprain, tightness
  - Ligamentum teres tears
  - Fem neck stress frx
  - Osteonecrosis
  - Loose bodies
  - Young patients
    - SCFE
    - Perthes
    - DDH
- Extra-articular
  - **Bands**
    - IT band, Psoas tendon
  - **Strains**
    - Gluteus medius, adductor, hamstring, rectus
  - **Bursitis**
    - Trochanteric, iliopsoas, ischial
  - Nerve entrapment
    - Perineal, obturator
  - Infection
  - Osteitis pubis
  - Hip pointer

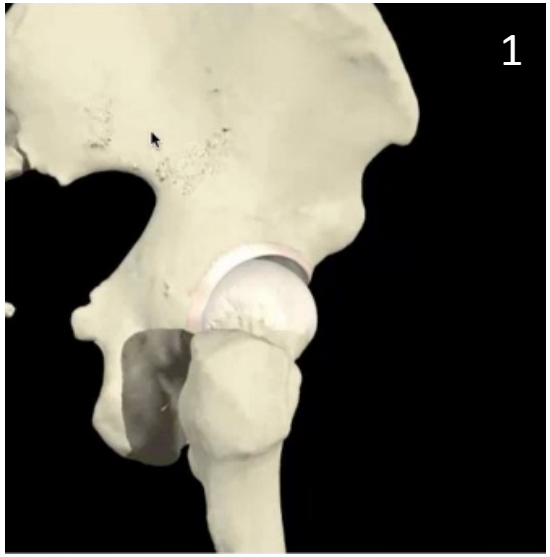
Algorithmic approach

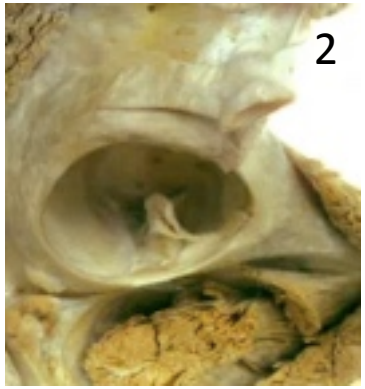


History

- History
- Duration of pain
- Location
- Treatments
- Depth/Layers
  - Bony (Layer 1)
    - FAI/Version/Alignment/Frx
    - Mechanical
  - Static (Layer 2)
    - Labrum/Cartilage/Capule
    - Mechanical
  - Dynamic (Layer 3)
    - Cardinal points
  - Neural/Soft tissue (Layer 4)
    - diagnosis of exclusion

Layers

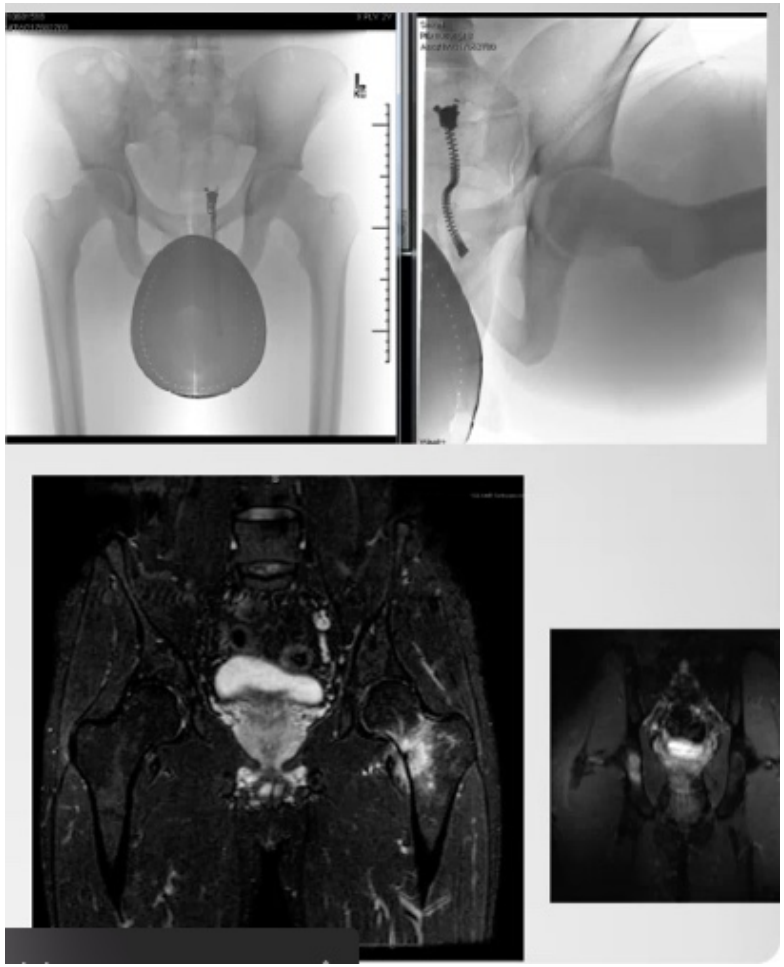




- 1: Mechanics of joint
- 2: Inert layer
- 3: Dynamic layer
- 4: Neural layer

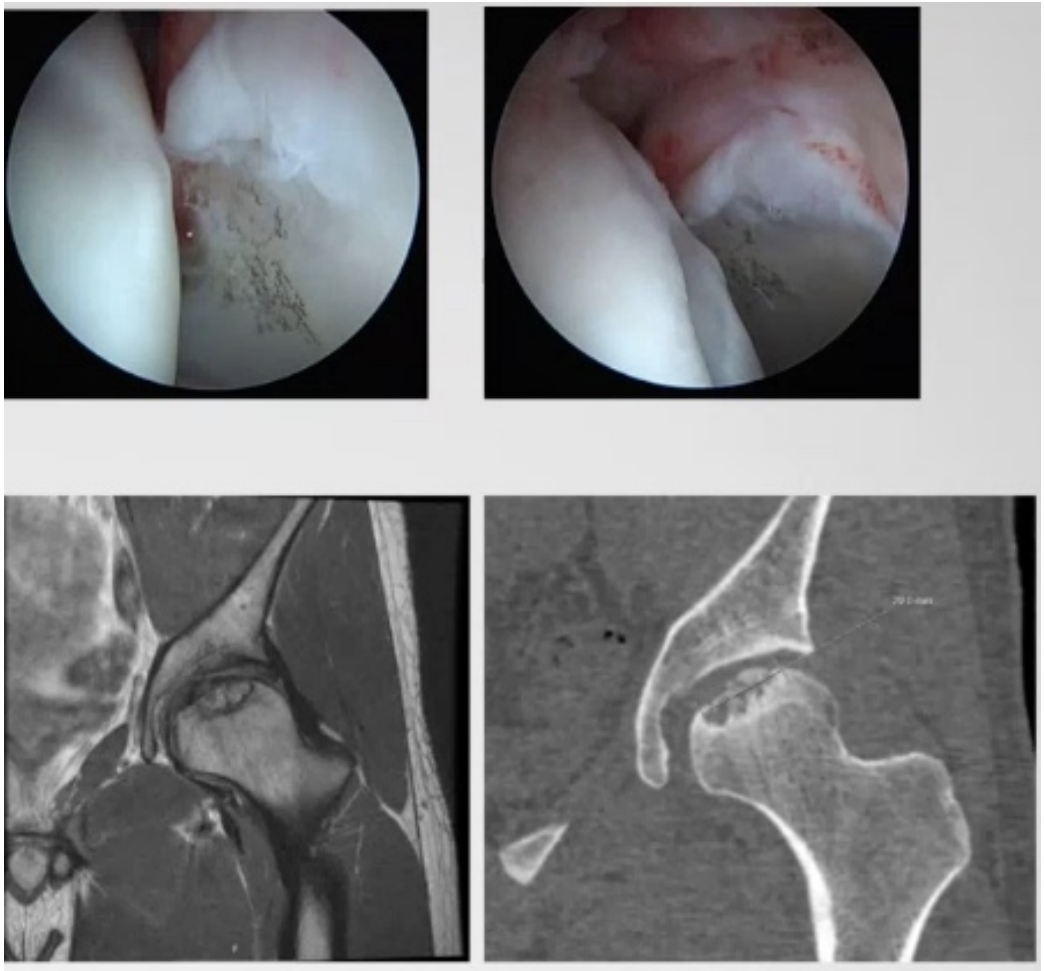
Layer 1

- Hip Mechanics
  - FAI
  - Version disorders
  - Femoral neck stress frx
  - Pelvic and sacral stress frx



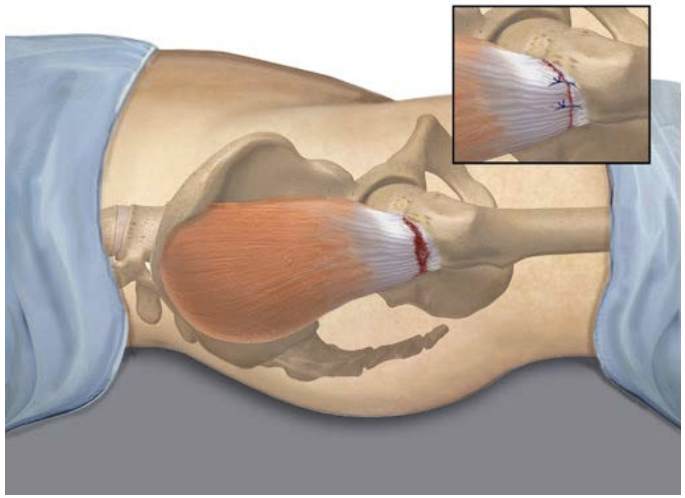
Layer 2

- Inert layer
  - Acetabular labral tears
  - Cartilage injuries
  - Osteoarthritis
  - Capsular injury/capsulitis
  - Often coupled with layer 1 injuries



Layer 3 = Dynamic Layer (cardinal points)

- Anterior
  - Iliopsoas
    - Internal coxa saltans
    - Tendonitis
    - Bursitis
  - Rectus femoris
    - tendonitis
    - avulsion
  - ASIS/AIIS (pediatrics)
    - Impingement
- Lateral (older population)
  - Gluteal muscles
    - Tendonitis/bursitis
    - Abductor overuse (dysplasia)
  - Proximal IT Band
    - External coxa saltans



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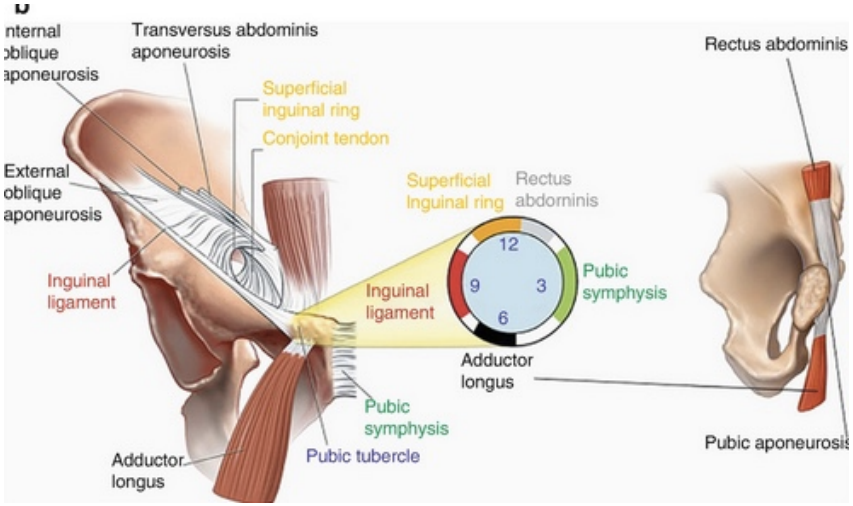
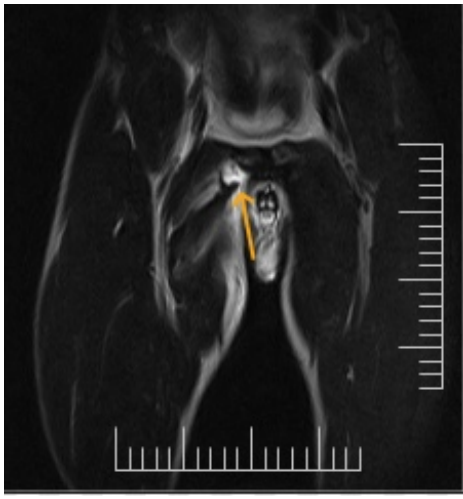
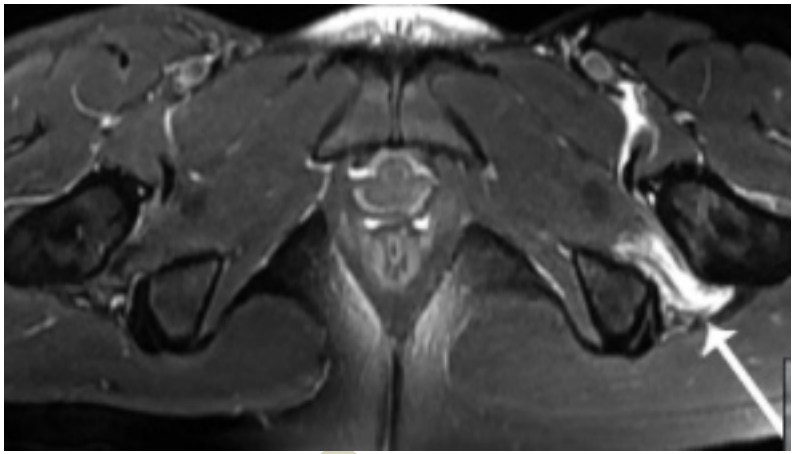
Layer 3 Continued

- Medial
  - Adductors
    - Acute tears
    - Athletic pubalgia
    - Increased pelvic motion compensating for decreased hip motion
- Posterior
  - Hamstring
    - Acute avulsion
    - Acute on chronic
    - Myotendinous
    - Ischial tuberosity avulsion
  - Ischiofemoral impingement
    - Quadratus femoris impinged







Layer 4

- Neural layer
  - Entrapments
    - Meralgia paresthetica
    - Obturator nerve
    - Ilioinguinal/genitofemoral
  - Surgery
    - LFCN
    - pudenal

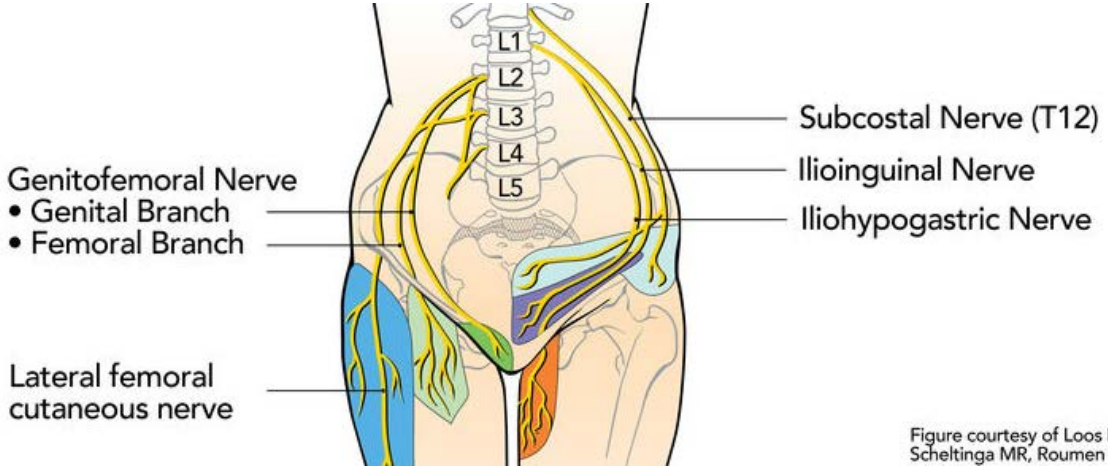
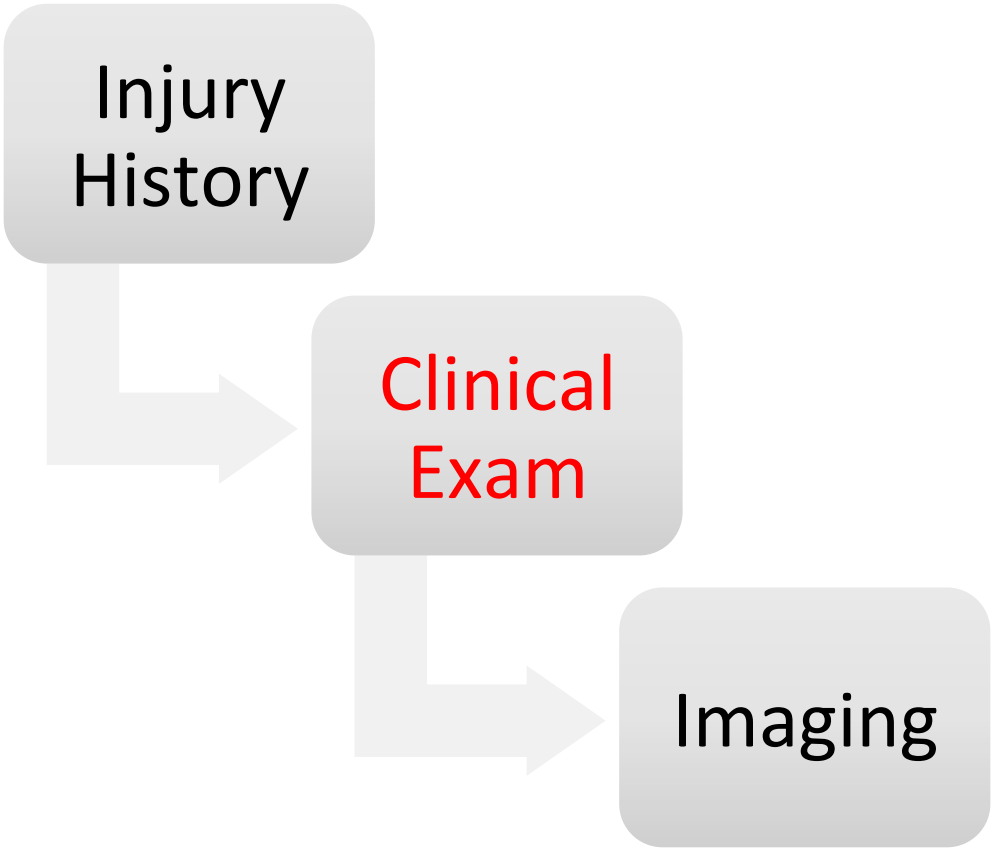


Figure courtesy of Loos
Scheltinga MR, Roumen

Algorithmic approach



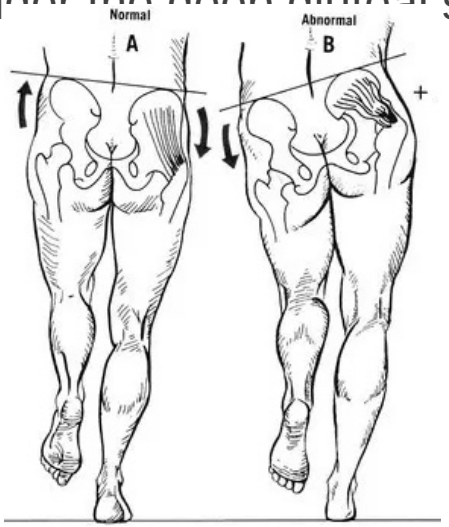
Normal Passive Hip ROM

- Adduction: 30°
- Abduction: 45°
- Flexion: 110°
- Extension: 0°
- Internal rotation: 30°
- External rotation: 50°

Physical Exam – FAI specific

- Range of Motion:
  - Often Decreased flexion in both internal and external rotation
- Neuro:
  - Often normal
- Strength:
  - Normal except when associated with tendinopathies

- Special Tests
  - **C sign**
  - **Anterior Impingement (FADIR)**
  - **Stinchfield**
  - Posterior Impingement
  - FABER
  - Trendelenburg
  - Consider the deep gluteal space



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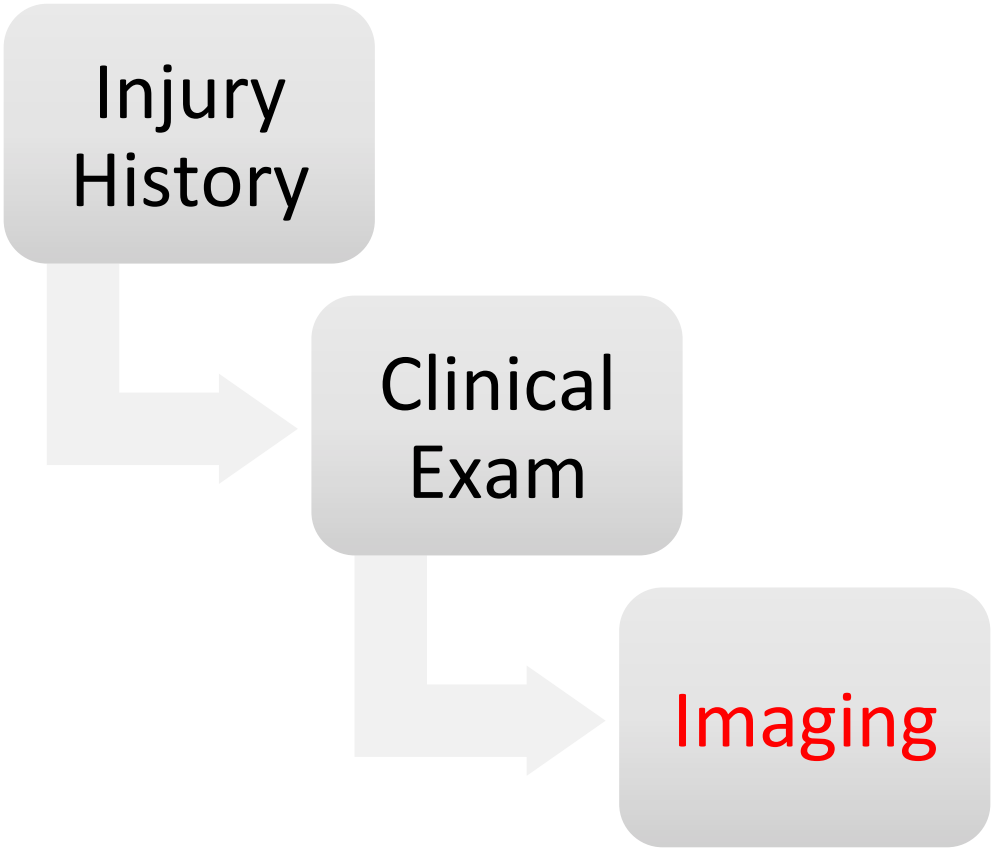
Adductor/core muscle injury

- Resisted adduction of the knees
- Half sit up - resisted

Algorithmic approach

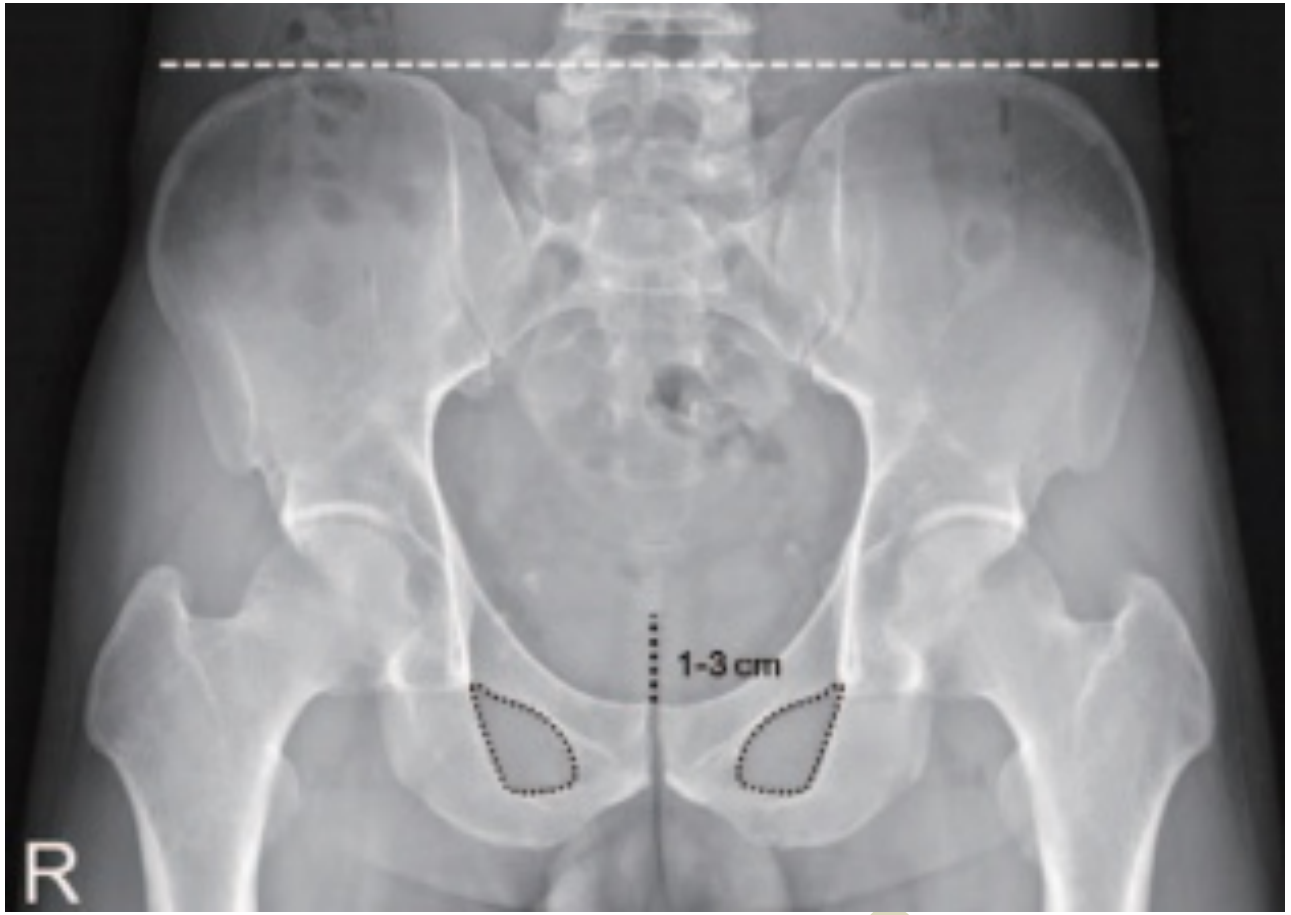


Imaging

A Systematic Approach to the Plain Radiographic Evaluation of the Young Adult Hip

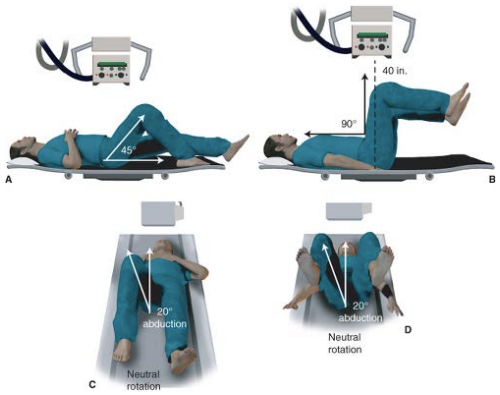
By John C. Clohisy, MD, John C. Carlisle, MD, Paul E. Beaulé, MD, Young-Jo Kim, MD, Robert T. Trousdale, MD, Rafael J. Sierra, MD, Michael Leunig, MD, Perry L. Schoenecker, MD, and Michael B. Millis, MD

- Always start with a good AP of the pelvis!!!

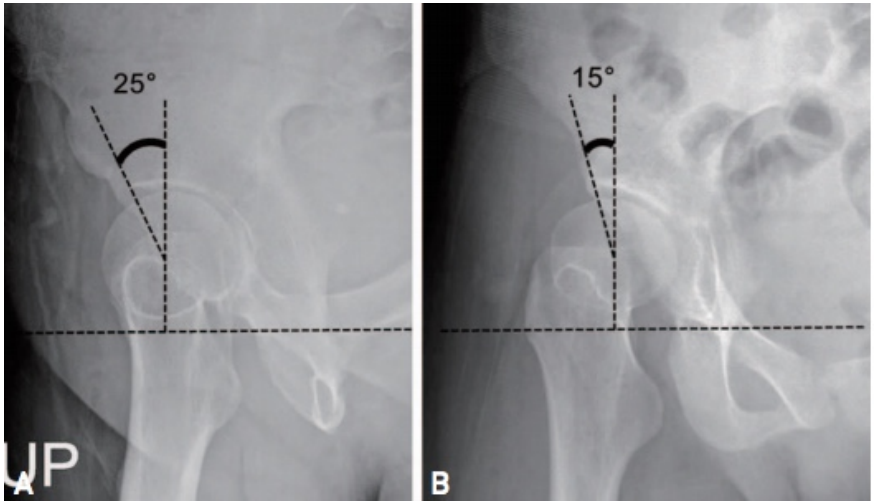


Next Views

- Dunn view

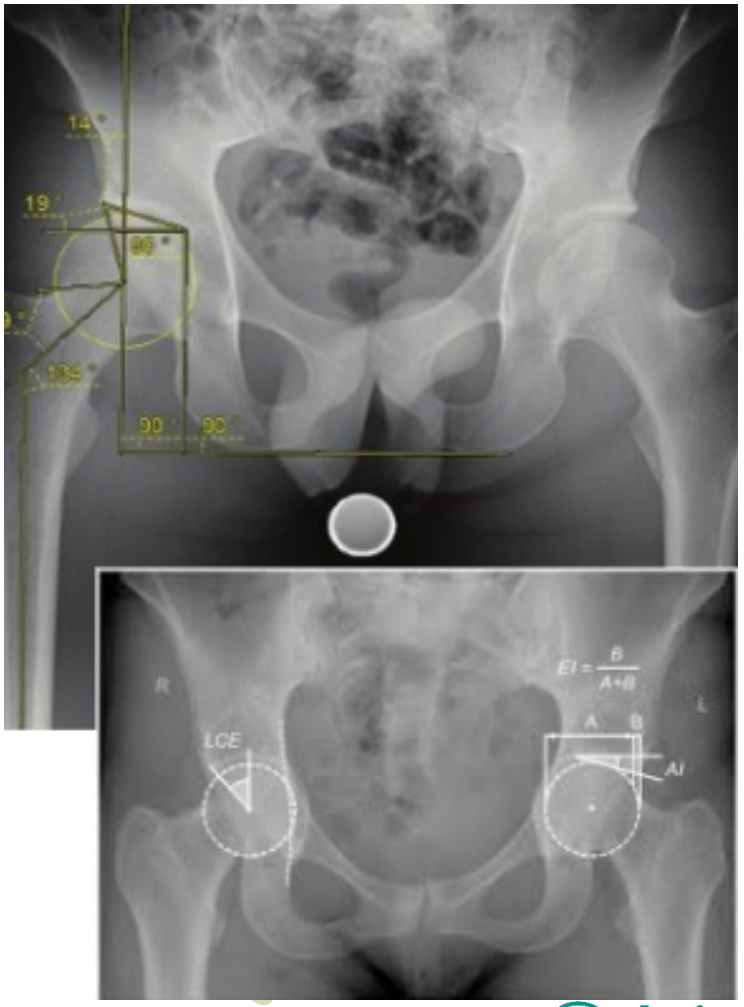


- False profile



Mnemonic for Systematic Eval

- Pathology
  - Fracture
  - Tumors
  - SCFE
  - Perthes
- Arthritis
- Acetabulum
  - Version
  - Dysplasia
  - Protrusio/Profunda
- Impingement
  - CAM
  - Pincer
- Neck
  - Neck shaft angle



Arthritis

TONNIS CLASSIFICATION OF HIP OSTEOARTHRITIS; 1999

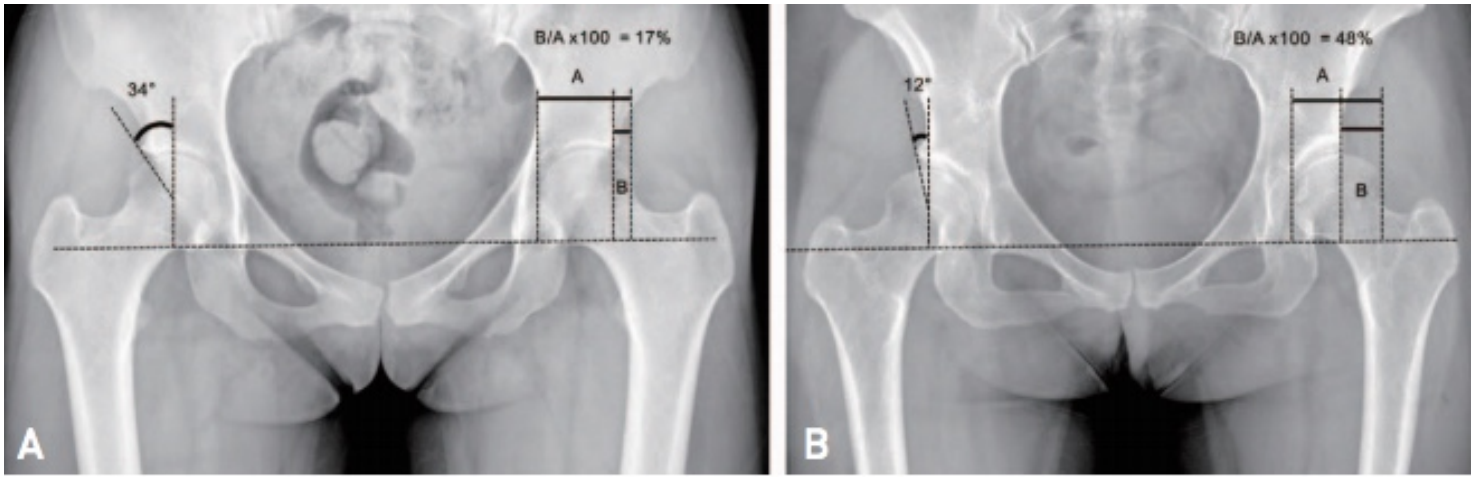
Grade	Radiographic features
0	- No signs of osteoarthritis
1	- Slight narrowing of joint space - Slight lipping at joint margin - Slight sclerosis of the femoral head or acetabulum
2	- Small cysts in the femoral head or acetabulum - Increasing narrowing of joint space - Moderate loss of sphericity of the femoral head
3	- Large cysts - Severe narrowing or obliteration of joint space - Severe deformity of the femoral head - Avascular necrosis

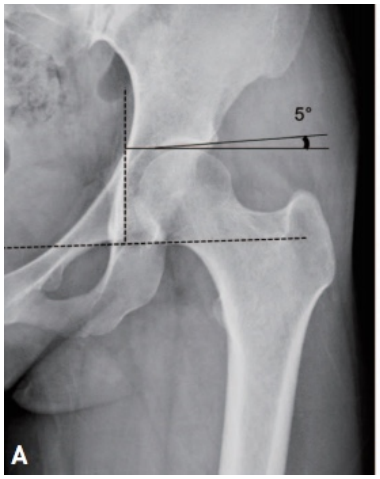
Kovalenko, B., Bremjit, P., & Fernando, N. (2018). Classifications in Brief: Tönnis Classification of Hip Osteoarthritis. *Clinical Orthopaedics and Related Research®*, *476*(8), 1680-1684.

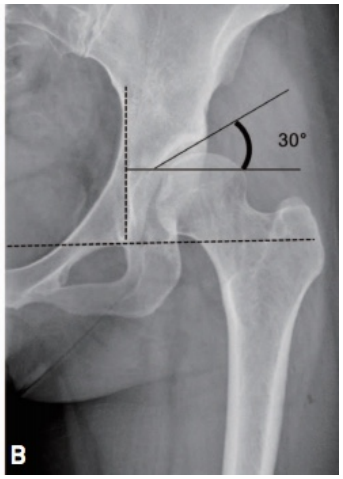
von Bernstorff, M., Feierabend, M., Jordan, M., Gilatzel, C., Ipach, I., & Hofmann, U. K. (2017). Radiographic hip or knee osteoarthritis and the ability to drive. *Orthopedics*, *40*(1), e82-e89.

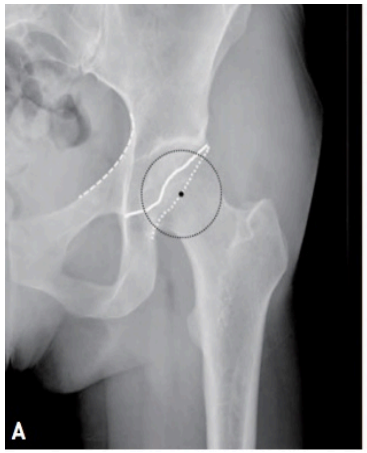
Acetabulum

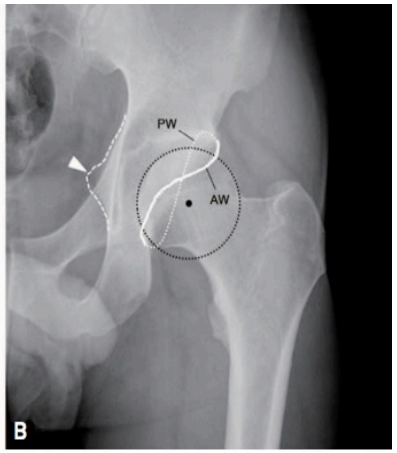
- LCEA
- ACEA
- Extrusion
- Protrusio
- Version
- Index





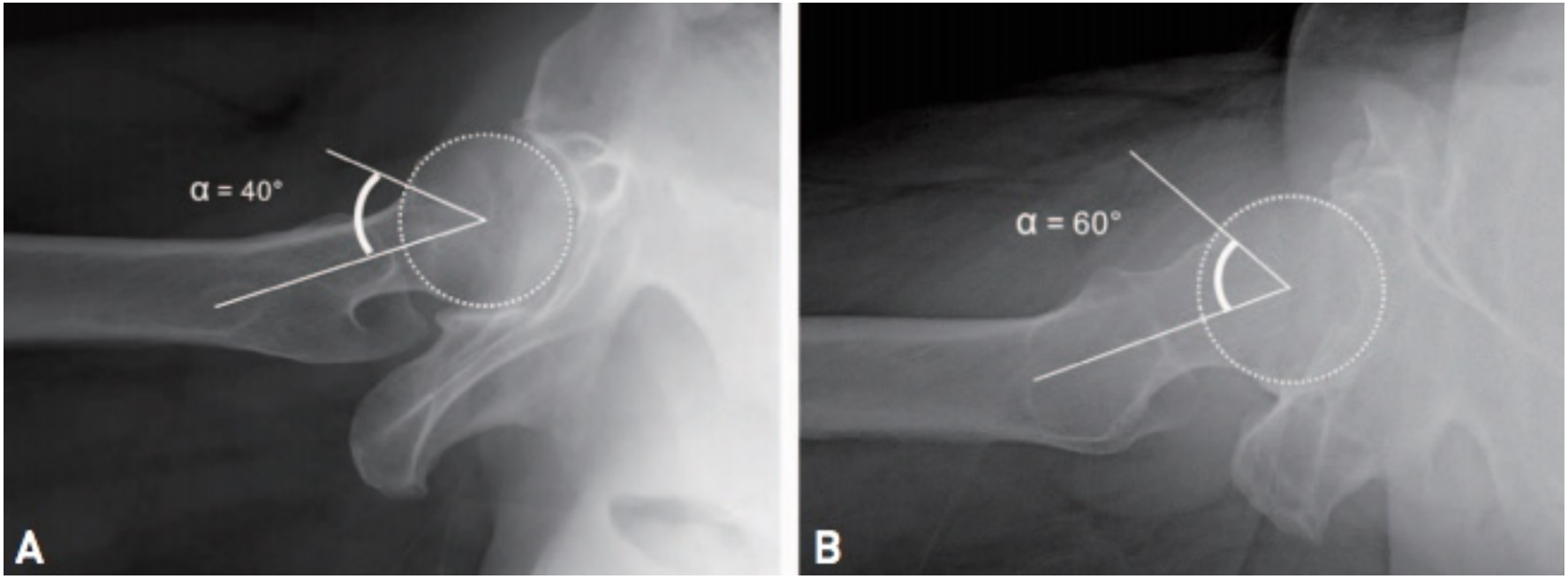






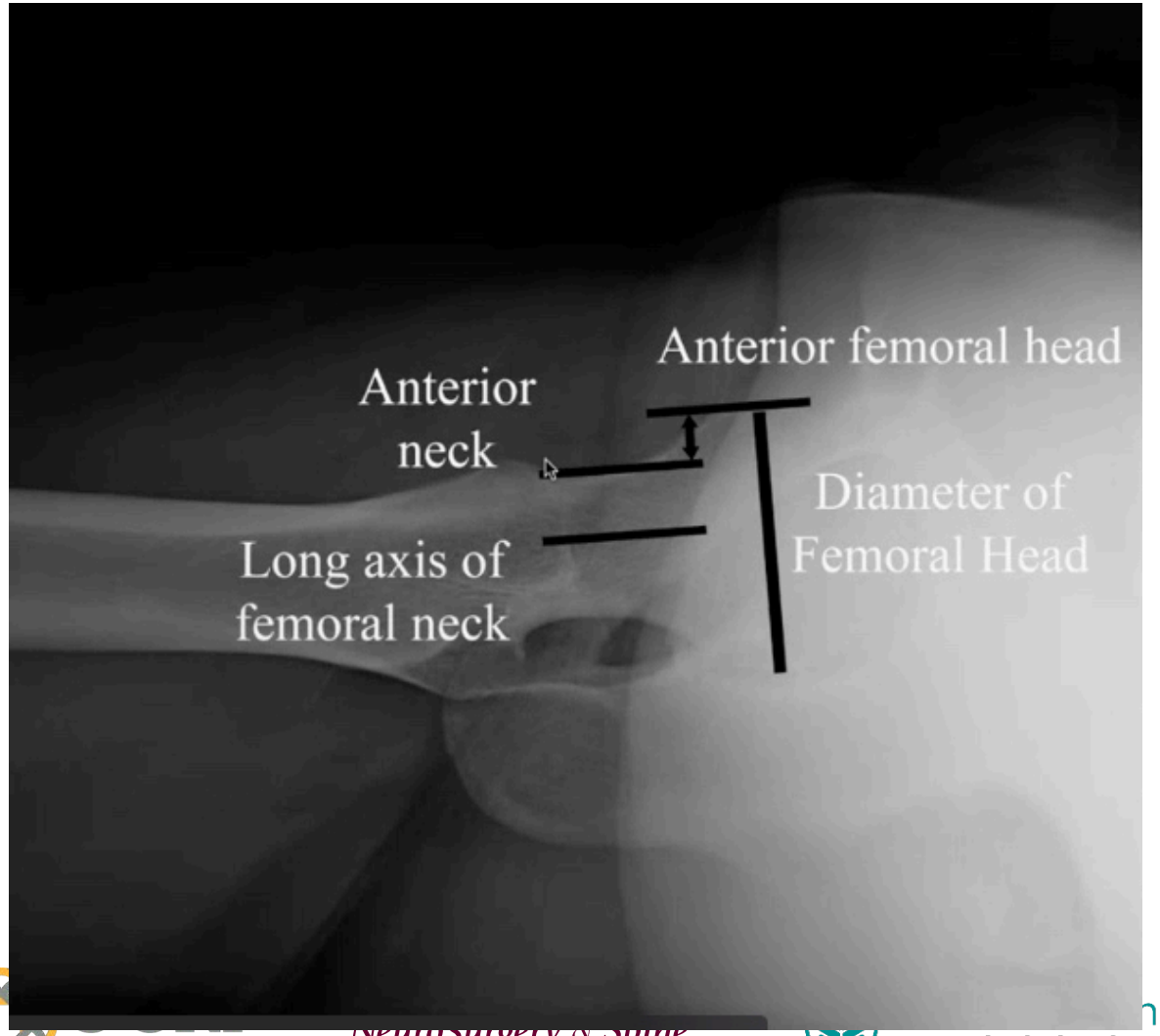
Impingement (Cam) – Alpha Angle

- Alpha
  - <50



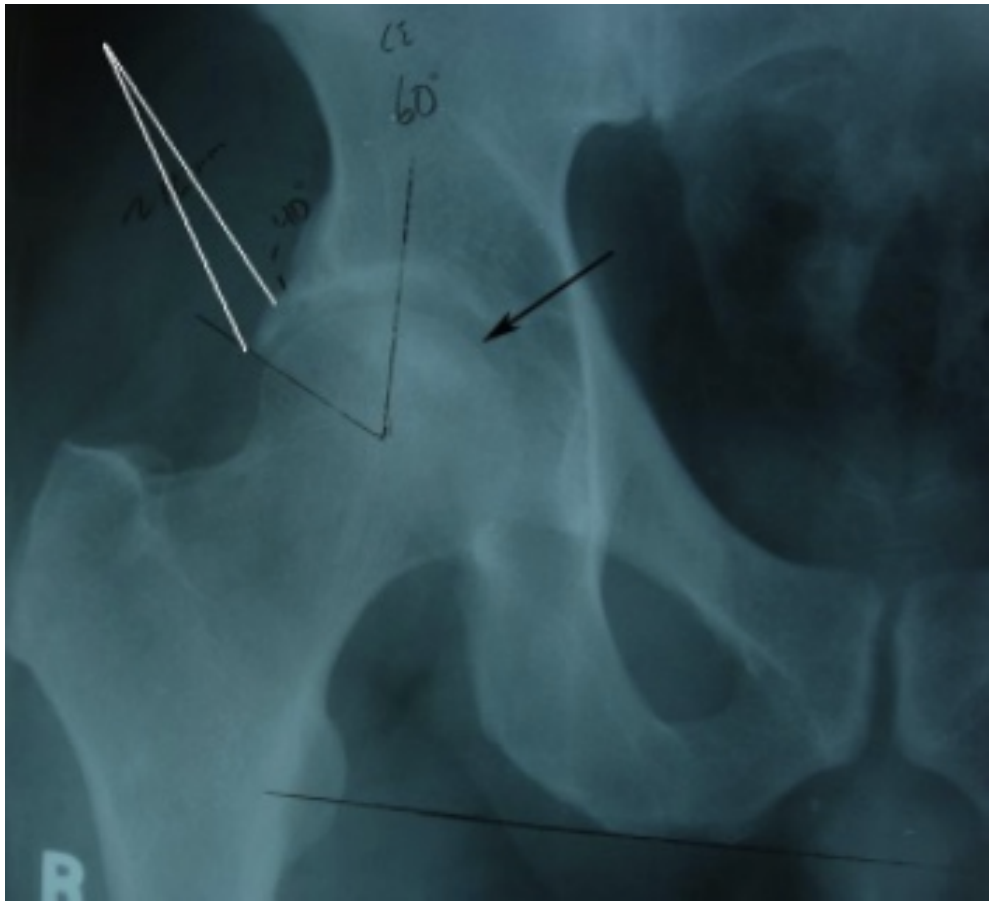
Impingement (Cam) - Offset

- Head – Neck Offset
  - Normal: >0.17
  - Normal offset = 9-11mm



Impingement (Pincer)

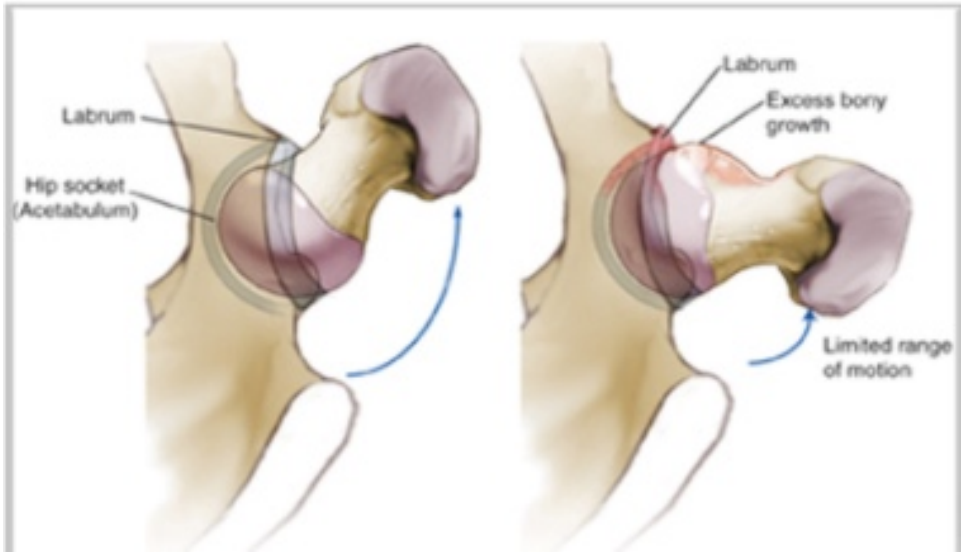
- Pincer



Neck

Femoroacetabular Impingement

- What is it?
  - Mismatch between bony anatomy and motion needed
- What causes it?
  - Orientation of acetabulum
  - Depth of acetabulum
  - Femoral head/neck junction
- Associated Injuries?
  - Labrum
  - cartilage
- Prognosis?
  - Can lead to early osteoarthritis



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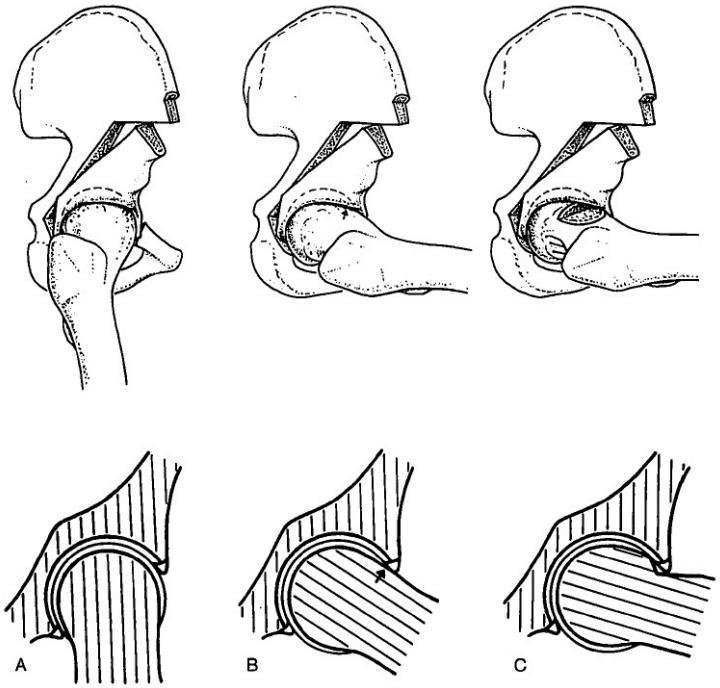
“Femoroacetabular Impingement”

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 363, pp. 93–99

Anterior Femoroacetabular Impingement After Periacetabular Osteotomy

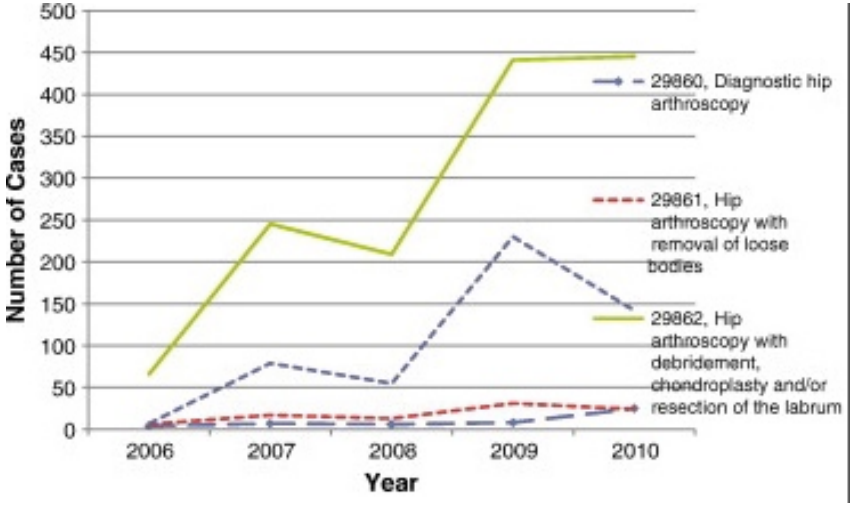
S.R. Myers, MD; H. Eijer, MD; and R. Ganz, MD

- Case Report of 5 patients s/p Bernese PAO
- Developed groin symptoms and decreased hip ROM years later after correction
- Open surgical dislocations revealed “anterior impingement”



Since then ……

- Correction of pathology performed arthroscopically late 90s, early 2000
- Clinical outcomes based studies ~2005
- 2007 – 2011: 250% increase



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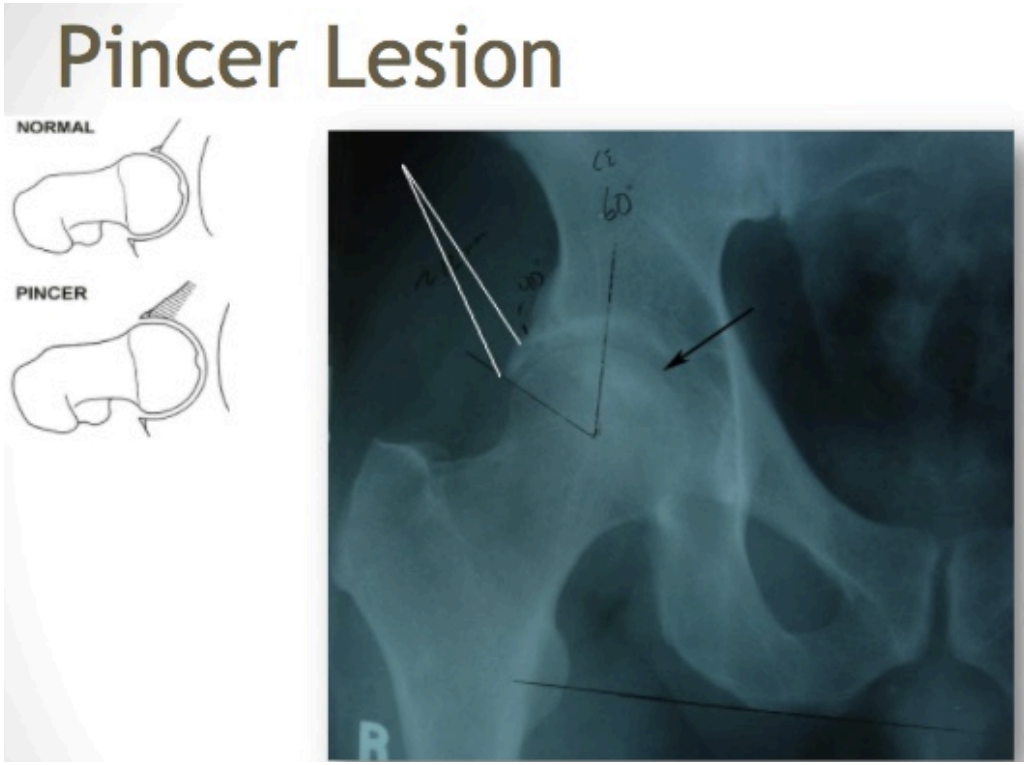
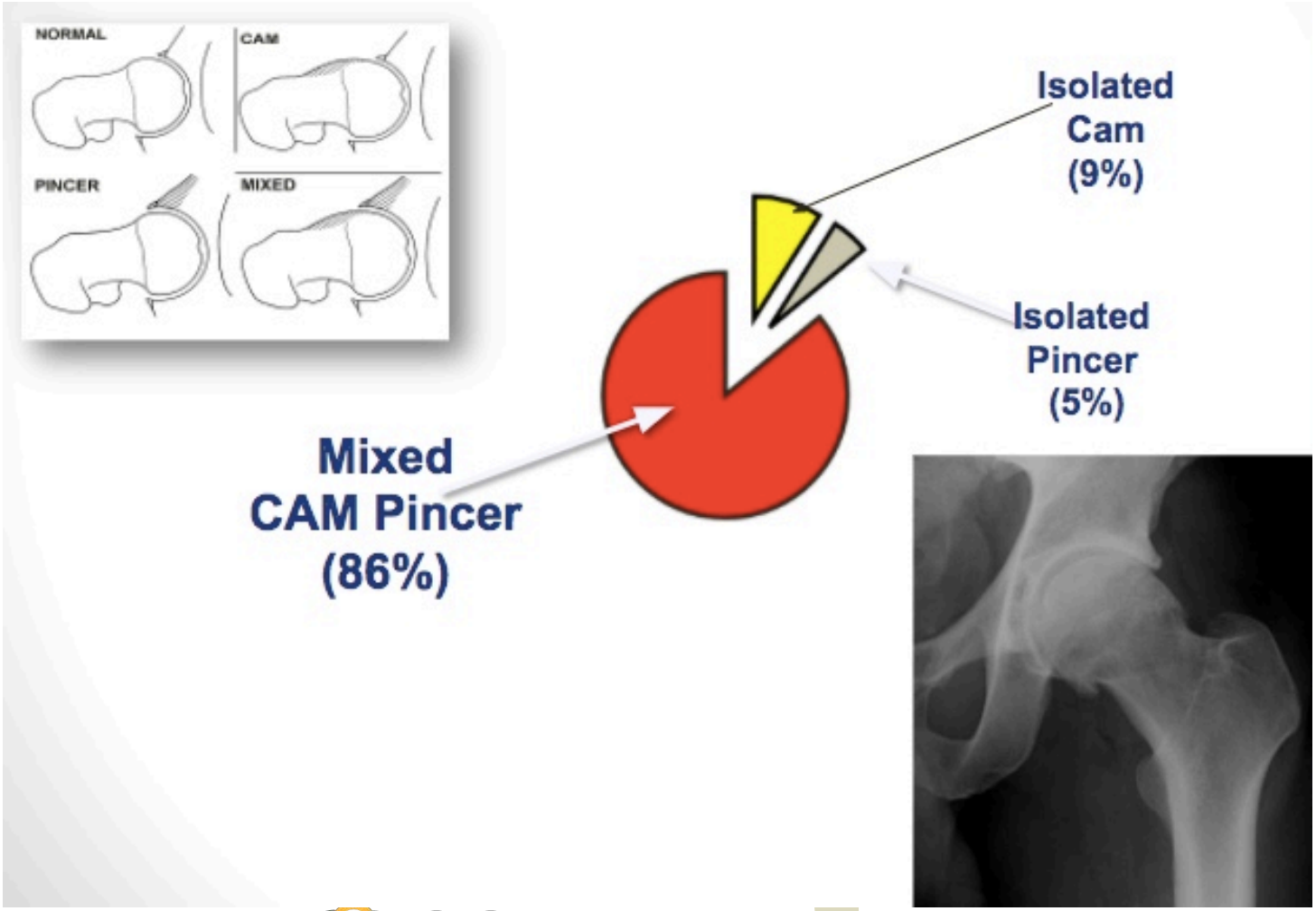
FAI


CAM Lesior
NORMAL
CAM
R
©ernest schilders


Pincer Lesion
NORMAL
PINCER
60°
R

Majority = Mixed



How do FAI injuries Occur in Athletes?

- Contact sports
- Repetitive rotational movements
  - Adduction, Abduction, IR, ER
- Falls
- Lateral impact injury
- Forceful contractions combined with limited anatomy

Who does FAI affect?

Reported Prevalence of Radiographic Cam Deformity Based on Sport

A Systematic Review of the Current Literature

Derrick M. Knapik,*†‡ MD, Michael A. Gaudiani,‡ BS, Brian E. Camilleri,§ DO, Shane J. Nho,‖ MD, James E. Voos,†‡ MD, and Michael J. Salata,†‡ MD

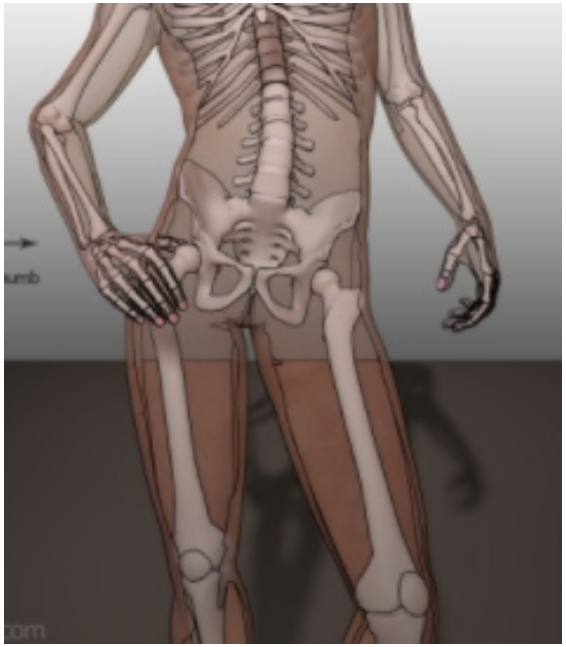
Investigation performed at Sports Medicine Institute, University Hospitals Cleveland Medical Center, Cleveland, Ohio, USA

TABLE 2
Reported Number of Radiographic Cam Deformities Based on Sport[a]

		Radiographic Cam Deformity, n		Alpha Angle, deg[b]		Athlete Age, y[b]	
Sport	Studies, n	Male	Female	Male	Female	Male	Female
Soccer	9	554	20	62.4 ± 6.8	50.1 ± 10.4	21.7 ± 4.2	21.4 ± 3.4
Hockey	8	269	—	61 ± 5	—	19.0 ± 3.8	—
American football	4	241	—	57.8 ± 5.2	—	21.6 ± 1.0	—
Ballet/dance	3	12	15	54	48.3 ± 1.7	24.7	21.9 ± 4.7
Track and field	2	9	14	52.3	50.2 ± 3.0	22.9	22.4 ± 2.9
Basketball	1	33	—	60.5	—	17.6	—
Martial arts	1	20	3	—	—	23	23
Golf	1	11	—	66	—	29	—
Skiing	1	11	—	55.2	—	15.2	—
Volleyball	1	—	1	—	39	—	19.2

Presentation

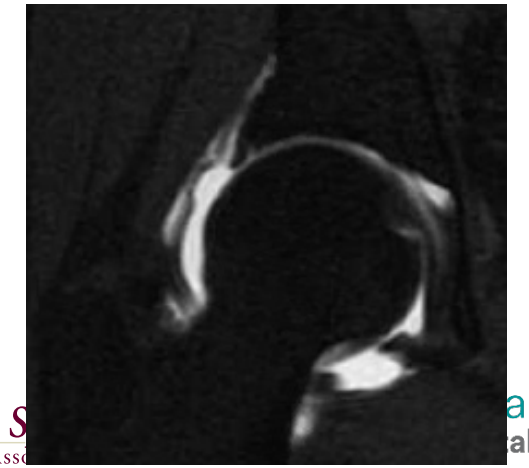
- Pain
  - Groin
  - Buttock
  - Insidious
  - **Can be worse after sitting for long periods of time**
  - Deep flexion sports
  - Radiation into thigh (does not go below knee)
- Symptoms
  - No neuro symptoms
  - Some mechanical symptoms
  - Can report sense of instability
- Positive C-sign



Advanced Imaging in FAI

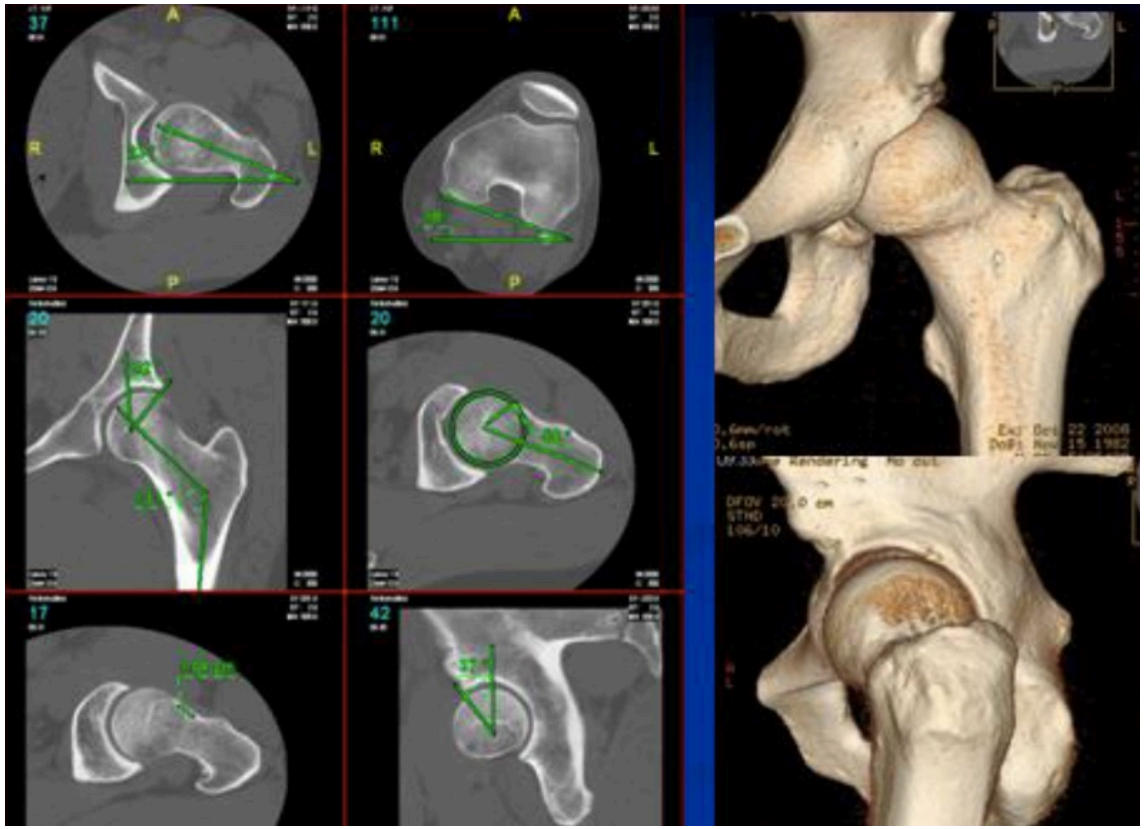
- XR
  - Crucial for establishment of bony morphology
    - CAM
    - Pincer
    - Acetabular version/depth
  - Rule out fracture/avulsion
  - Evaluation for OA

- MRI
  - Great structural tool
  - Confirmation of history/PE findings
  - BAD SCREENING TOOL
    - High rate false positives
    - 44% labral tears in asymptomatic pts
    - Cartilage defects:
      - Femoral head: 6%
      - Acetabulum: 14%
  - 3T MRI best, hip specific
    - Avoid pelvis unless indicated

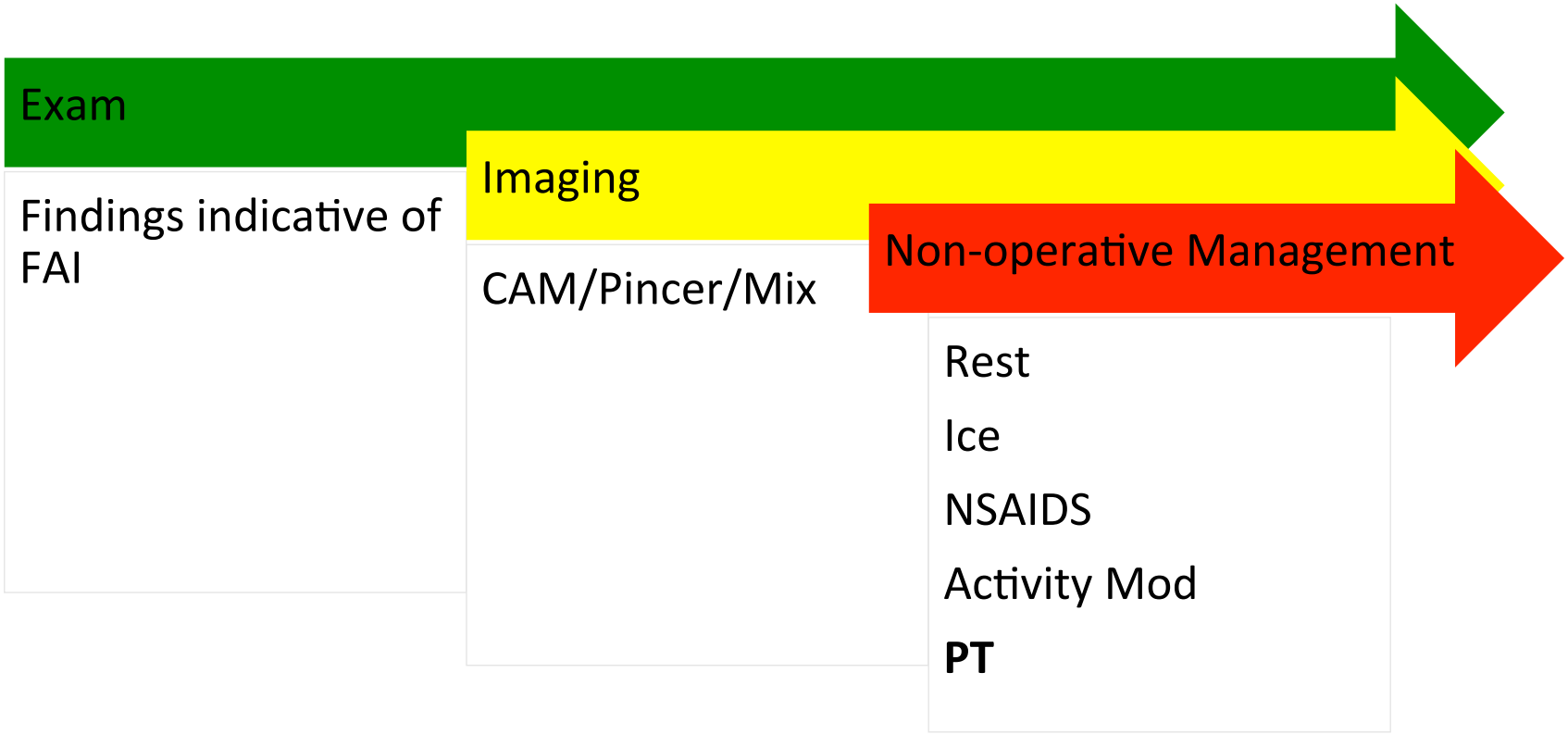


Advanced Imaging in FAI (cont.)

- CT:
  - Invaluable for determining size and location of cam/ pincer lesions
  - Best for evaluating bony anatomy/mechanics
  - Important for early surgeons
  - 3 dimensional interpretation (always better than 2D)



Treatment Algorithm

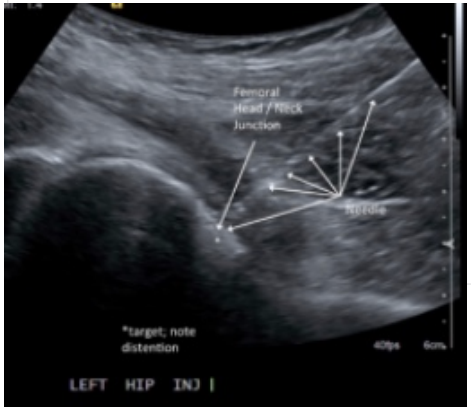


Treatment Algorithm

Intra-articular Injection

Diagnostic

Therapeutic



Response

Positive:

Continue non-op versus surgical Tx

Negative:

Consider non-hip etiologies of pain

Evaluate Surgical Indications

Tonnis grade

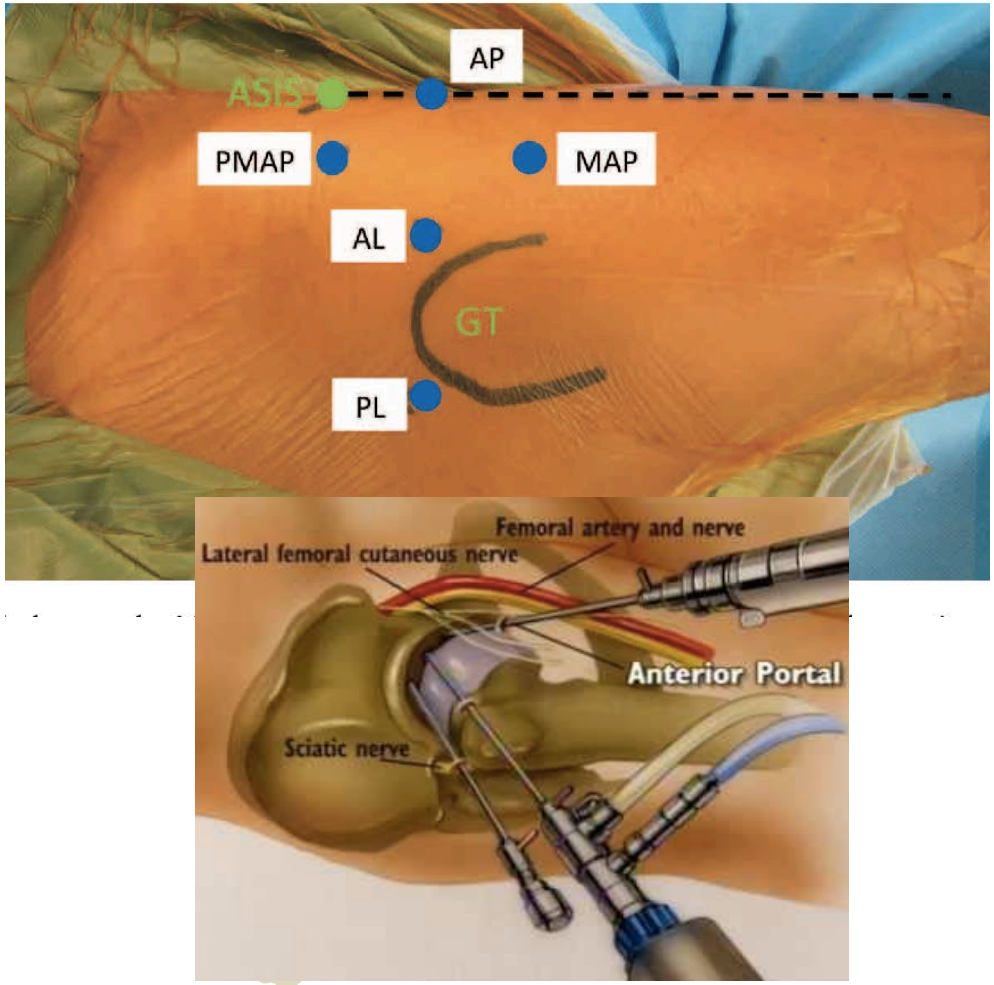
Center Edge Angle

CAM/Acetabular Version

Concomitant pathology

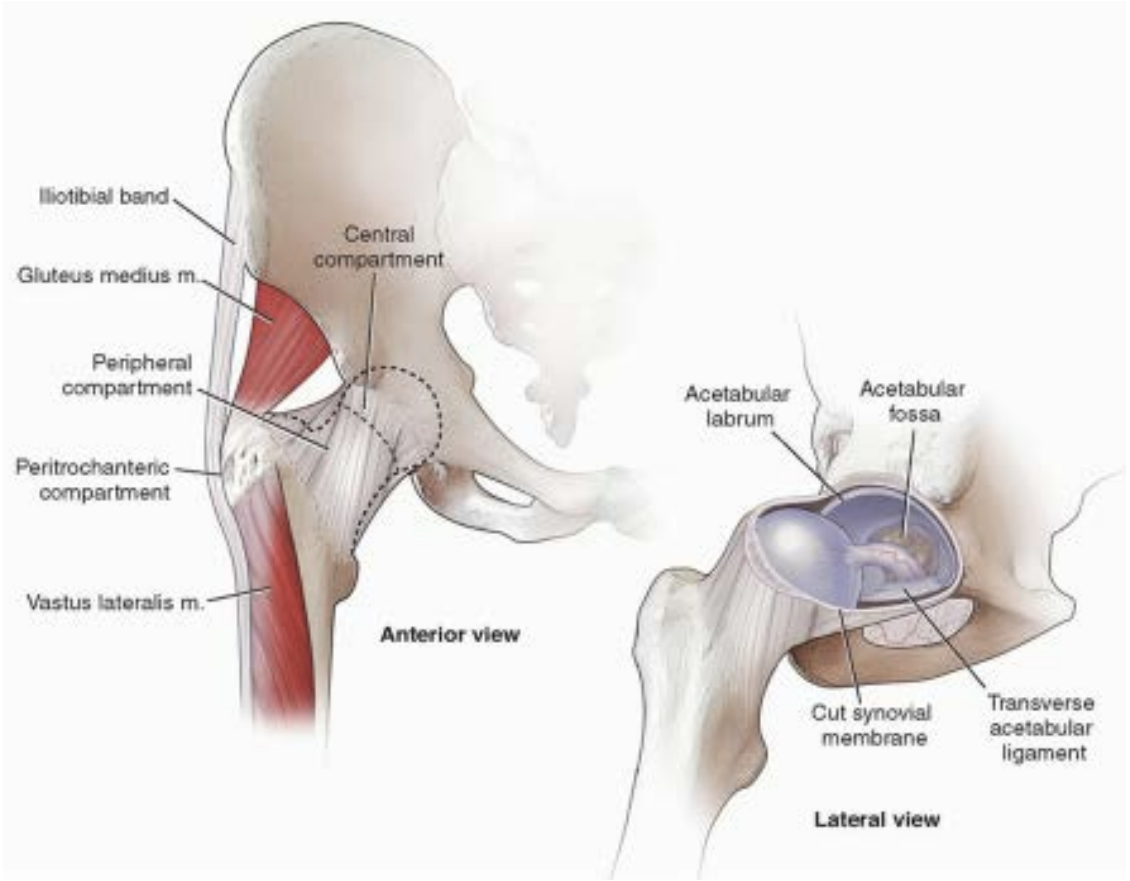
Hip Arthroscopy – portal placement

- Approach/Technique
- 2 or 3 portals
  - Standard
    - Anterior
    - Anterolateral
    - MAP/DALA
  - Adjunct
    - DALA
    - Posterolateral portal

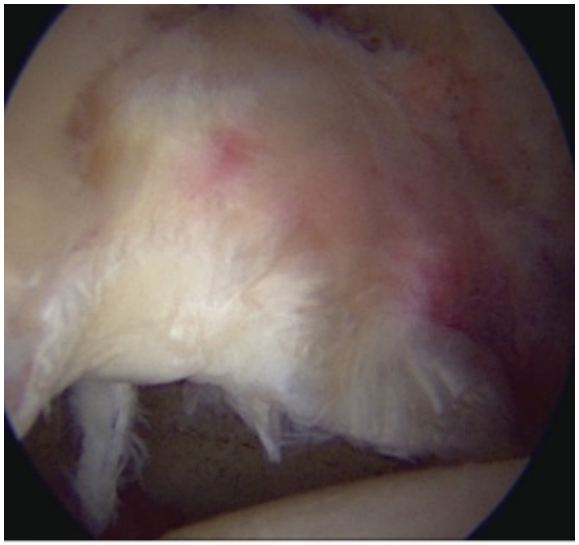


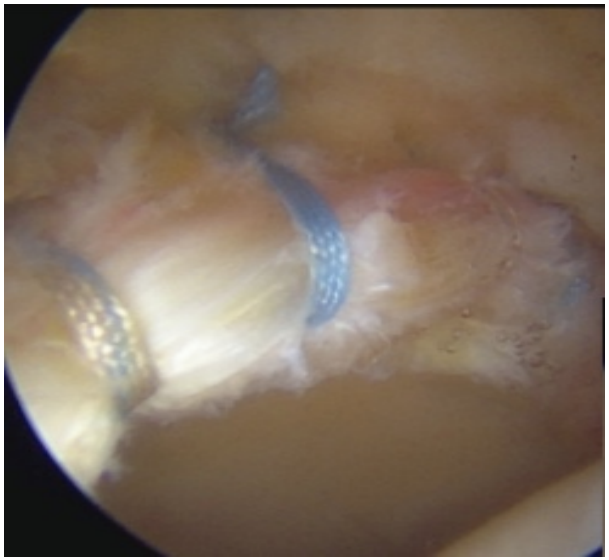
Hip arthroscopy – portal visualization

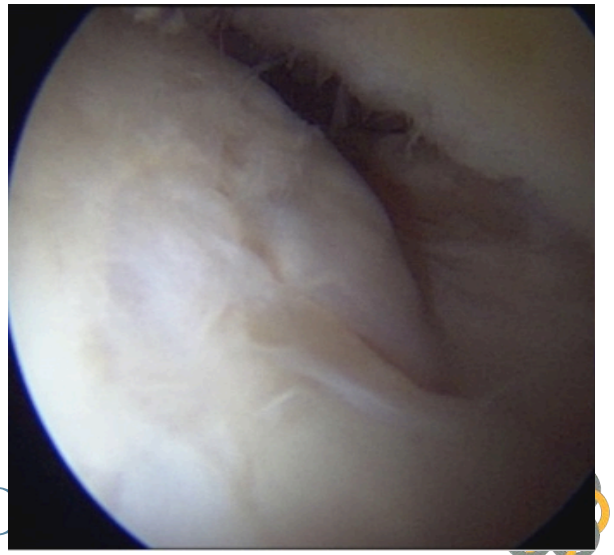
- Central compartments
  - Establish portals
  - Inter-portal cuts
  - Diagnostic scope
  - Acetabuloplasty
  - Labral repair
- Peripheral compartments
  - T-cut
  - Osteochondroplasty
  - Capsule repair

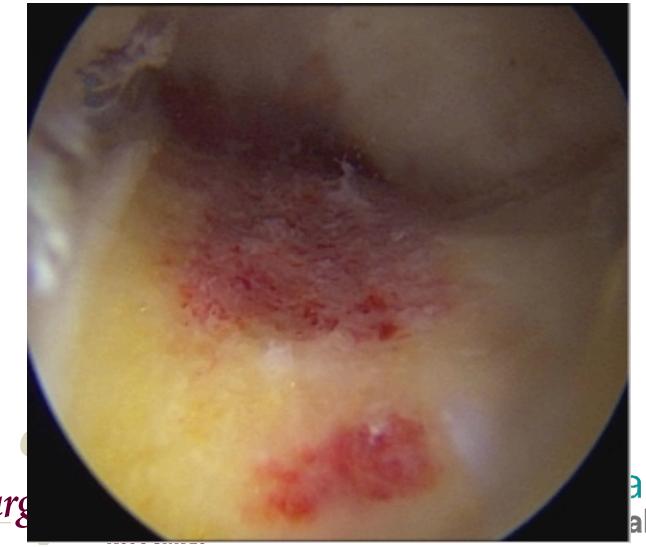


Hip arthroscopy = FAI goals





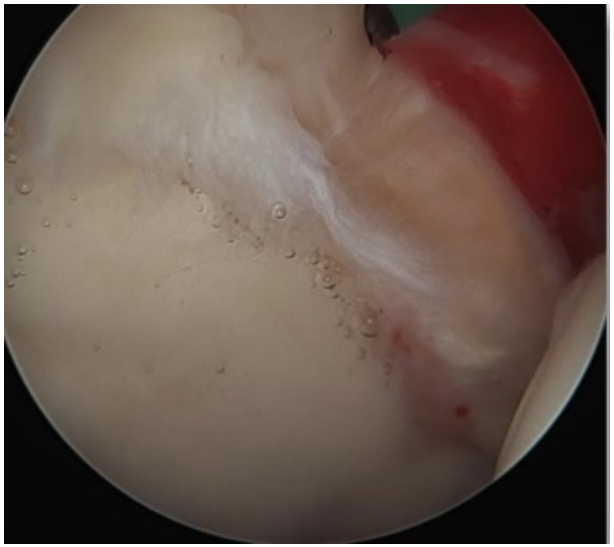


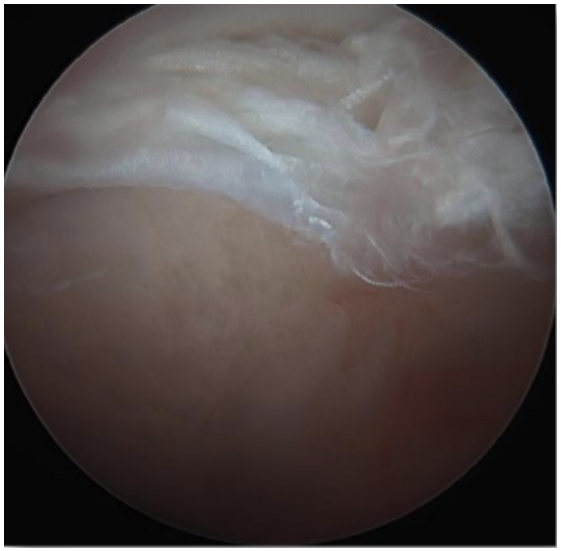


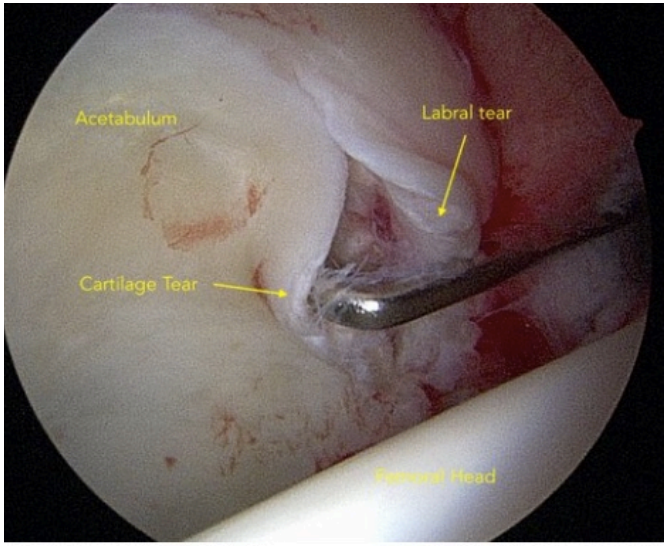
FAI outcomes

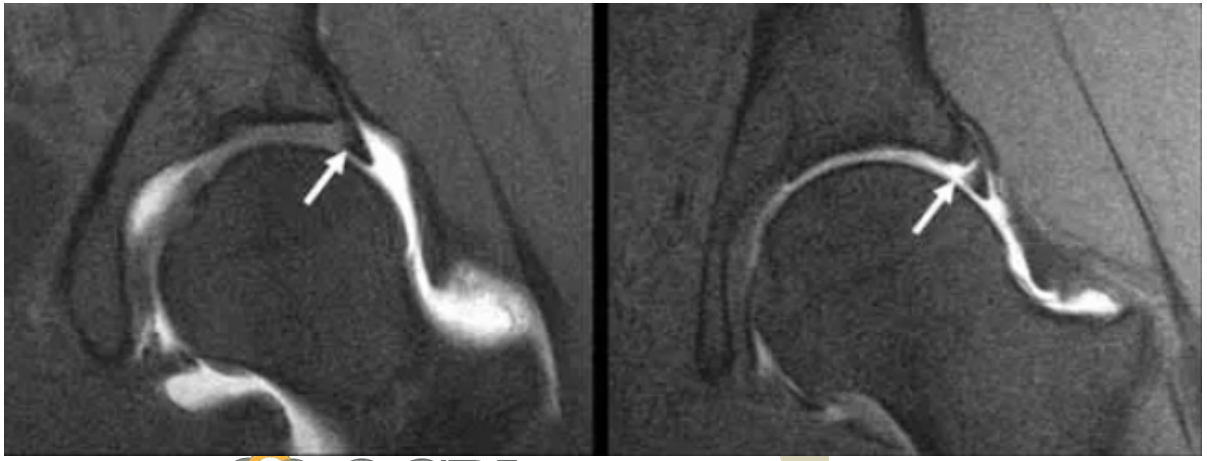
- Surgical success
  - 95% (defined as elimination of pain)
- Return to sport
  - 95% professional athletes; 85% collegiate athletes
- Average time RTS
  - 6 – 9 months
- Average improvement ROM
  - IR: 20°, flexion: 10°
- Complication rate
  - 1.4% (Byrd and Villar);
    - Traction: 0.5%; HO 1.6 – 6%; dislocation <1%; AVN <1%; Frx
    - Revision rate: 5-10%
- 90% revision due to inadequate cam revision

Associated Injuries – Labral Tears



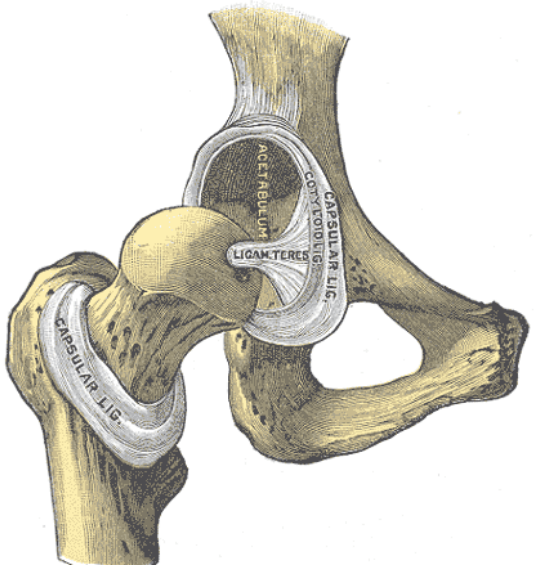




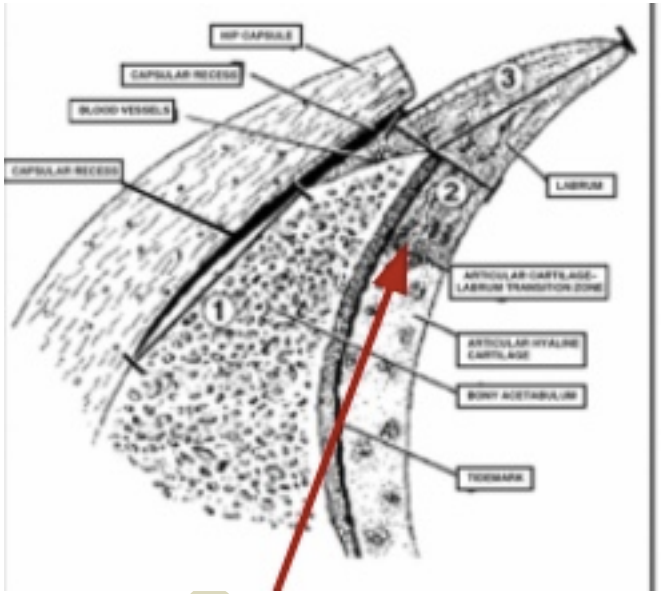


Labrum Anatomy & Function

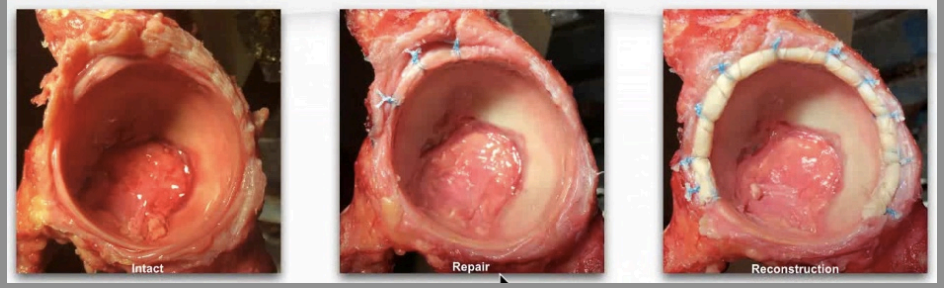
- Deepens socket (21%)
- **Creates suction seal**
- Increases contact area (28%)
- Pain generator (nociception)
- proprioception



- Triangular shape
- Circumferential contact
- Radial fibers
- **Continuous with acetabular cartilage**

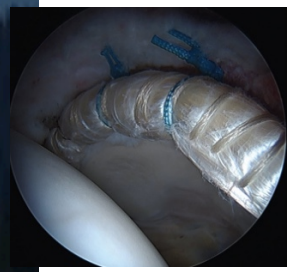


Treatment Algorithm



Labral Treatment Algorithm

- Evaluate Labrum
  - Repairable
    - Labral Repair
  - Irreparable
    - Debridement
    - Augmentation
    - Reconstruction



Labral Repair Outcomes

> Arthroscopy. 2017 Sep;33(9):1679-1684. doi: 10.1016/j.arthro.2017.03.011. Epub 2017 May 10.

Return to Sport and Clinical Outcomes After Hip Arthroscopic Labral Repair in Young Amateur Athletes: Minimum 2-Year Follow-Up

Rohith Mohan [1], Nick R Johnson [1], Mario Hevesi [1], Christopher M Gibbs [1], Bruce A Levy [1], Aaron J Krych [2]

- 92% return to sport, improved HHS
- Detachment of labrum and reattachment has worse outcomes

Orthop J Sports Med. 2018 Feb; 6(2): 2325967117752307. PMCID: PMC5802644
Published online 2018 Feb 5. doi: 10.1177/2325967117752307 PMID: 29435469

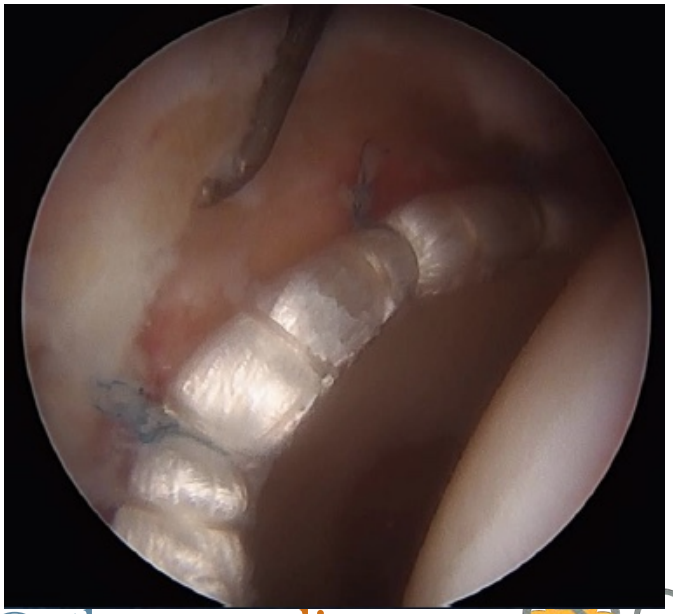
Prevalence and Impact of Hip Arthroscopic Surgery on Future Participation in Elite American Football Athletes

Derrick M. Knapik, MD,[*†‡] Joe Sheehan, ATC,[§] Shane J. Nho, MD,[‖] James E. Voos, MD,[§] and Michael J. Salata, MD[§]

- No risk of decreased ability to participate at elite level
- 93% had labral repairs, 35% FAI resection

Labral reconstruction outcomes

- Short term
- 75-90% success rate
- 85% RTS athletes
- 10% conversion THA



Arthroscopy. 2017 Sep;33(9):1685-1693. doi: 10.1016/j.arthro.2017.03.015. Epub 2017 May 29.

Arthroscopic Reconstruction of Segmental Defects of the Hip Labrum: Results in 22 Patients With Mean 2-Year Follow-Up.

Chandrasekaran S[1], Darwish N[1], Close MR[1], Lodhia P[1], Suarez-Ahedo C[1], Domb BG[2].

Am J Sports Med. 2013 Aug;41(8):1750-6. doi: 10.1177/0363546513487311. Epub 2013 May 3.

Acetabular labral reconstruction with an iliotibial band autograft: outcome and survivorship analysis at minimum 3-year follow-up.

Geyer MR[1], Philippon MJ, Fagrelius TS, Briggs KK.

Arthroscopy. 2016 Jan;32(1):26-32. doi: 10.1016/j.arthro.2015.07.016. Epub 2015 Oct 1.

Allograft Use in Arthroscopic Labral Reconstruction of the Hip With Front-to-Back Fixation Technique: Minimum 2-Year Follow-up.

White BJ[1], Stapleford AB[2], Hawkes TK[2], Finger MJ[2], Herzog MM[3].

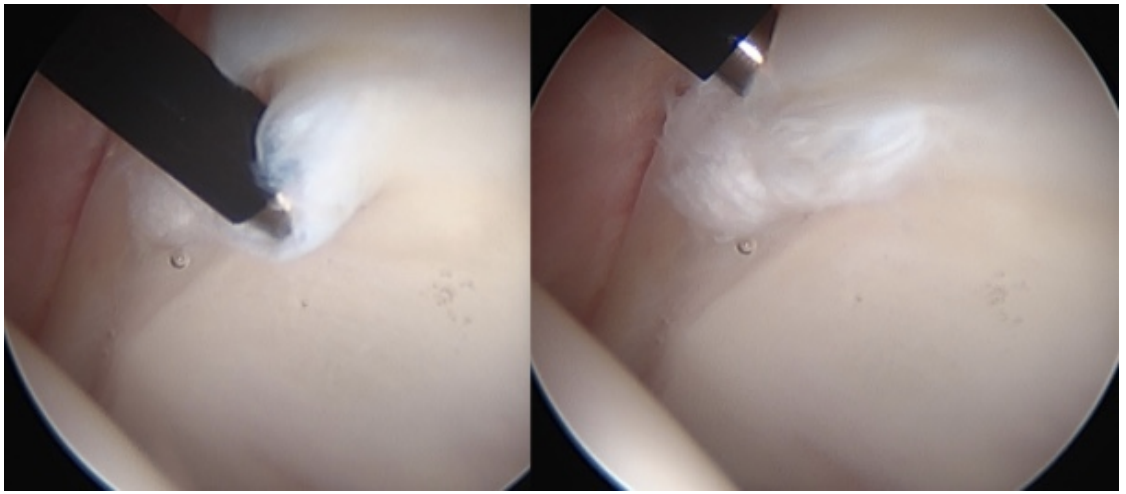
Am J Sports Med. 2013 Oct;41(10):2296-301. doi: 10.1177/0363546513498058. Epub 2013 Aug 8.

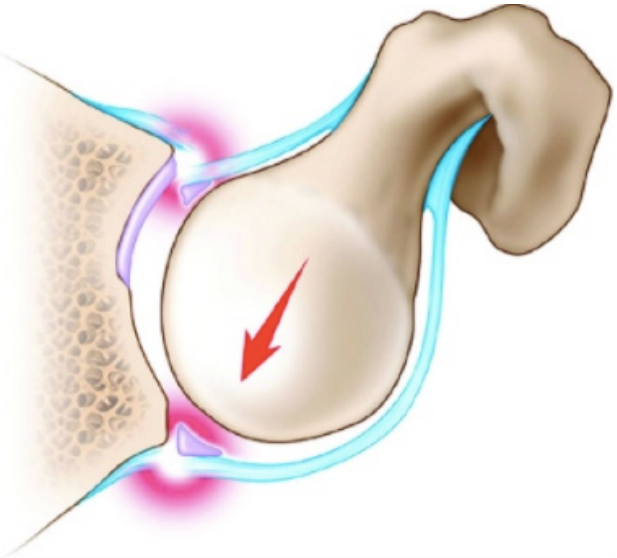
Results of arthroscopic labral reconstruction of the hip in elite athletes.

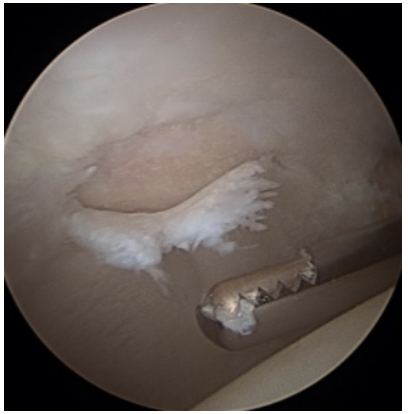
Boykin RE[1], Patterson D, Briggs KK, Dee A, Philippon MJ.

Cartilage Injuries

- Wave sign
  - Delamination site
- Contre-coup injuries
- Acute traumatic chondral effects
- Surgical options
  - Microfracture
    - Small well circumscribed lesions
  - Fetal cartilage
    - Difficult to do (requires dry field)
  - OATS
    - Lack of donor site







Post Op Rehab

- Labral debridement/acetabular work
  - WBAT
  - Emphasis on ROM
- Labral repair
  - PWB
  - Avoid extremes of flexion and ER for 4-6 weeks
- Cam resection
  - WBAT w/ crutches to avoid twisting motion for 4 weeks
  - Full motor control obtained:
    - Closed chain, light exercise
  - High impact prohibited for 3 months

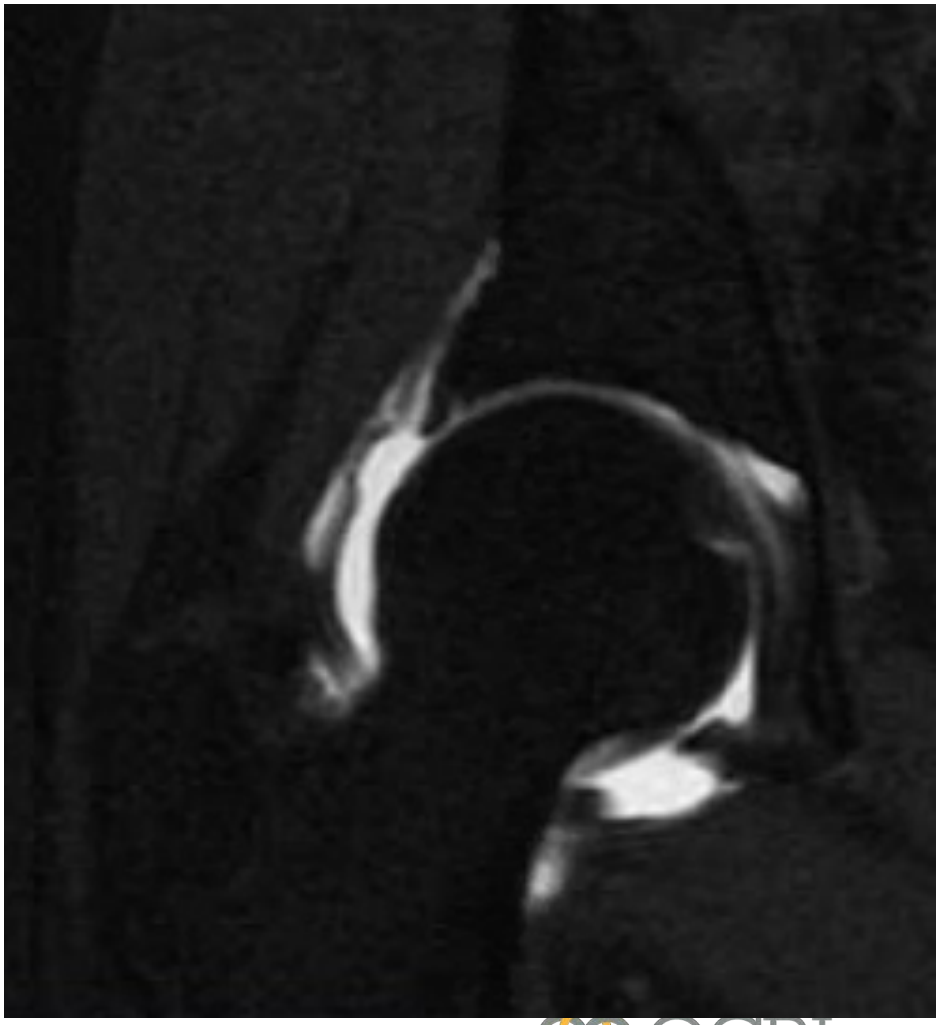
Case

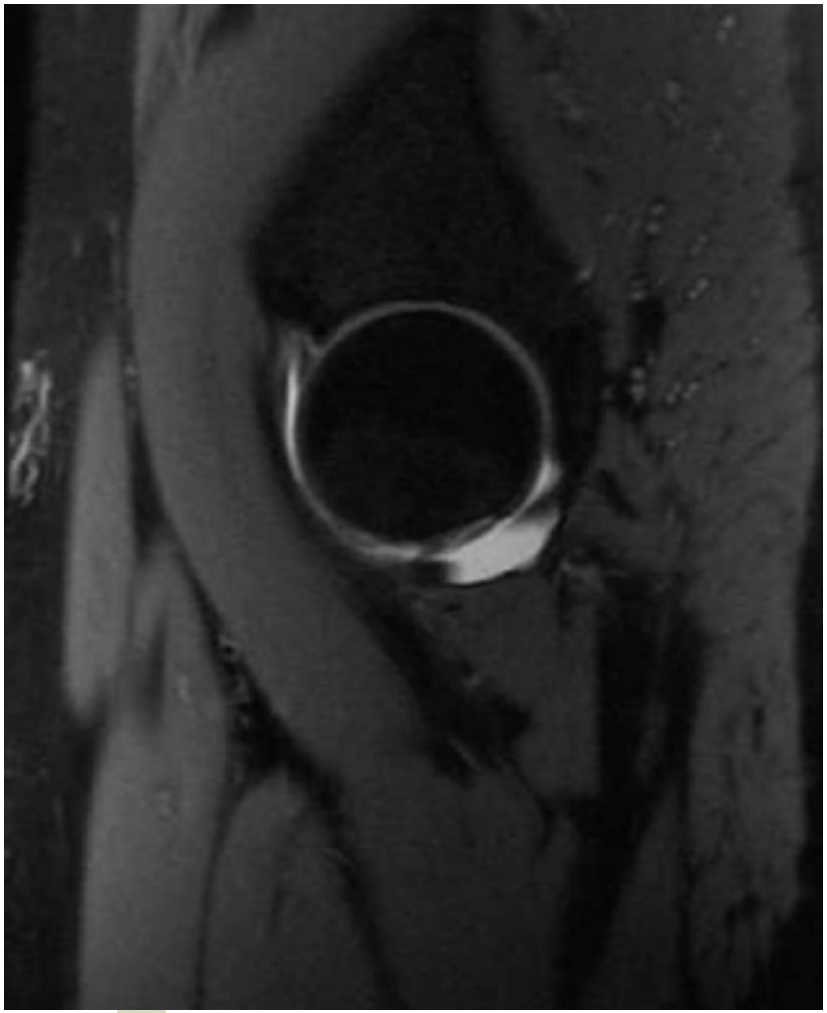
- Patient
  - 18 YOF DII soccer player with 2 years of hip pain
- Pain location
  - Hip/groin
  - anterior
- Duration
  - 2 years
- Previous Tx
  - PT
  - NSAIDS
  - Injection: relief for 2 months

- Exam
  - 5’4,130 lbs.
  - ROM
    - 100 FF
    - 20 IR (reproduces her pain)
    - 55 ER
  - Special
    - + FADDIR
  - Strength
    - 5/5 hip flexors and glutes
  - Neuro
    - intact

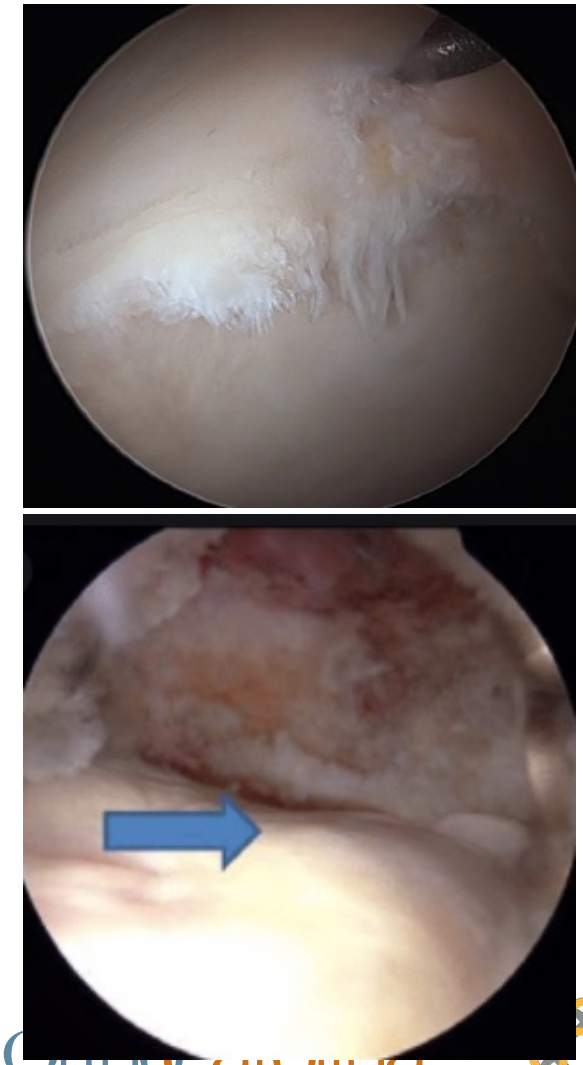
XR Imaging

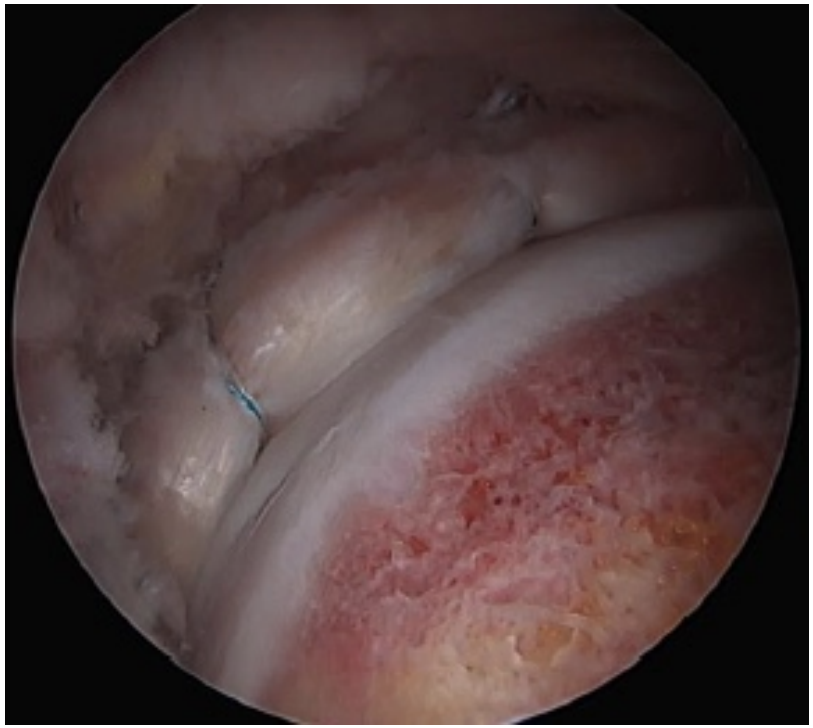
MRI Imaging





Intraop





Post op XR

Outcome

- Doing well
- Able to return to sport and play 2 seasons
- Mild pain after competition
- Otherwise no pain when not playing

Newest frontiers in hip arthroscopy

- Role of ligamentum teres
- Capsular closure/ management
- Biologics
- Clinical outcomes
  - Debride
  - Repair
  - reconstruction

THANK YOU

OrthoCarolina

Atrium Health